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VOL. 37. Ser. A. Part 12. pp. 445-488. DECEMBER, 1949.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

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THE EAST AFRICAN AGRICULTURAL JOURNAL

OF

Kenya, Tanganyika, Uganda and Zanzibar.

Editor :
Director of East African Agricultural Research Institute, Amani, Tanganyika.

Editorial Board :
Directors of Agriculture of Kenya, Tanganyika, Uganda and Zanzibar.

Published Quarterly in July, October, January, April.

Each volume consists of four issues, commencing with July number.

SUBSCRIPTION : Sh. 5/- per volume (including postage).

Subscriptions and all business communications to be addressed to the GOVERNMENT PRINTER, P.O. Box 128, Nairobi, Kenya.

¶ The last volume 1945-6 was No. XI—All previous volumes are out of stock.

Chiesa Molinari (O.) & Nicolea (H. G.). **Tratado general de olivicultura.** [A general Treatise on Olive-growing.]—9×6 ins., viii+491 pp., 322 figs., 17 pp. refs. Buenos Aires, El Ateneo, 1947. Price $ (Argent.) 21.

This book on olive-growing in Argentina contains a chapter (pp. 263–385) on the insect pests of olive in that and other South American countries, and many pests of olive in the Mediterranean region are included for comparative purposes. It is arranged systematically, and the information given on the individual species includes notes on morphology, distribution, life-history, the type of damage caused and in many cases control. Well over half the chapter consists of a section on Coccids, which are stated to be among the most injurious pests of olive in Argentina. This includes lists of species that attack the crop there and in the world, keys to genera and species and some higher groups, notes on identification and on the native and introduced parasites and predators, and an account of control by fumigation with hydrocyanic acid gas, with dosage tables.

Zogg (H.) & Salzmann (R.). **Bericht über die Tätigkeit der Eidg. landwirtschaftlichen Versuchsanstalt Zürich-Oerlikon für die Jahre 1942-1946. 8. Pflanzenschutz.** [Report of the Federal Agricultural Experiment Station Zürich-Oerlikon for the Years 1942–46. 8. Plant Protection.]—*Landw. Jb. Schweiz* **61** pt. 2 pp. 214–222. Berne, 1947.

Notes are given as for previous periods [*cf. R.A.E.*, A **35** 143] on the diseases and pests of various crops in Switzerland in the calendar years 1943–46. The hot dry summers of 1942 and 1943 checked the spread of *Leptinotarsa decemlineata*, Say, on potatoes, particularly in lightly infested areas, and facilitated control operations. In 1944 and 1945, however, strong winds from the west brought large swarms of the beetles into north-western districts, and numerous new foci of infestation occurred over almost the whole of Switzerland [*cf.* **35** 288]. Though the wet weather in 1946 was unfavourable for the beetle, it also hindered control. At the close of the period, only the south-east of the Grisons, a few valleys in the Alps, and the southern Ticino were free of infestation, but losses of potatoes were slight. Control is by means of inspection and treatment with calcium arsenate or DDT, which is obligatory in some areas.

Rape was injured by the rape stem weevil [*Ceuthorrhynchus napi*, Gylh.], outbreaks of which occurred in 1945 and 1946 in the Canton of Berne, the cabbage shoot weevil [*C. assimilis*, Payk.], which was also abundant in the same years, the rape flea-beetle [*Psylliodes chrysocephalus*, L.], larvae of which completely destroyed the growing points of the shoots of overwintered crops in the springs of 1944, 1945 and 1946, and larvae of the turnip sawfly [*Athalia rosae*, L.], which were numerous in all years. This sawfly has three generations a year, and becomes so common in autumn that it destroys whole fields of young rape in a few days. Dusts of derris or DDT give good control. The meadow moth [*Loxostege sticticalis*, L.] caused severe damage to young clover in 1946.

Jannone (G.). **La *Malacosoma neustria* L. o "campa" del mandorlo.** [*M. neustria*, a Pest of Almond.]—*Agric. pugliese* **1** no. 3 pp. 33–38, 3 figs. Bari, 1947.

Malacosoma neustria, L., is a troublesome pest of almond in the Province of Bari, Italy. Observations on its bionomics showed that it has one generation a year. The adults emerge between mid-May and early July and pair 1–2 days later, and the females oviposit soon after. The eggs, which are laid in masses round the young shoots, hatch in February–April, according to temperature. The larvae feed gregariously on the leaves, constructing a silken nest, and

(1668) Wt. P18/3825 1/50 S.E.R. Ltd. Gp. 432 [A]

pupate in silken cocoons spun between adjacent leaves or in cracks in the bark. The larval and pupal stages last 38–47 and 12–22 days, respectively. The eggs are parasitised by the Scelionid, *Telenomus terebrans*, Mayr, which has two generations a year, one in June–July, in the newly laid eggs, and the other from August to May–June of the following year, and the young larvae by an unidentified Tachinid. The control measures recommended are the removal of shoots bearing eggs during the winter, which is partly effected by the normal pruning operations, and spraying with 0·5 per cent. lead arsenate with an adhesive against the larvae in March–April.

Another pest of almond in the district is the Tingid, *Monosteira unicostata*, Muls. & Rey, which feeds on the buds and leaves, causing the latter to fall in August–September. It is spreading to fresh areas every year.

DELLA BEFFA (G.). **Gli insetti dannosi all'agricoltura e i moderni metodi e mezzi di lotta.** [Insects harmful to Agriculture and modern Methods and Means of Control.]—9¾×7 ins., xii+978 pp., 1310 figs. Milan, U. Hoepli, 1949. Price *Lire* 6500.

This is a revised and much enlarged second edition of a text-book on the insect pests of cultivated plants, forest trees and stored products in Italy and their control, of which the first volume of the original edition was published in 1932 [*R.A.E.*, A **20** 477]. The scope and general arrangement of the book remain unaltered, but the information has been brought up to date and much unpublished work of the author included. There is a short final section on animal pests other than insects. It is stated in the course of the work that *Leptinotarsa decemlineata*, Say, continues to spread on potato in Italy [*cf.* **35** 288] and appeared in Lombardy in 1946 and Venetia, Liguria and Emilia in 1947. *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., which had hitherto been confined to northern and central Italy [*cf.* **31** 180], was observed in the Province of Naples in 1946.

KANGAS (E.). **Beobachtungen über** *Lyctus planicollis* **Le Conte in Finnland.** [Observations on *L. planicollis* in Finland.]—*Ann. ent. fenn.* **13** no. 2 pp. 55–58, 1 fig., 9 refs. Helsinki, 1947.

Observations in Finland on *Lyctus planicollis*, Lec., in the handles of spades imported from England [*cf. R.A.E.*, A **23** 739] showed that the species is hardy, since it survived in the unheated warehouse in Helsinki from early 1934 until March 1935, when the infested material was destroyed. The temperature during the two winter periods involved reached minima of −10°C. and −13°C. [14 and 8·6°F.]. Some of the infested wood was kept in the laboratory and the beetles continued to breed in it until 1942. A fresh generation was produced each spring. The larvae and the damage they caused to the wood [*cf. loc. cit.*] are briefly described.

WILSON (G. F.). **The Leaf-rolling Rose Sawfly,** *Blennocampa pusilla* **Klug.**—*J. R. hort. Soc.* **72** pt. 4 pp. 155–158, 1 fig., 4 refs. London, 1947.

Blennocampa pusilla, Klug, which infests wild and cultivated roses, has become increasingly harmful in England during recent years. The leaflets of infested plants roll downwards and inwards and growth is retarded owing to interference with photosynthesis and respiration; when infestation is heavy, the foliage appears scorched and falls prematurely. The rolling, unlike that due to Tortricids, is complete and the leaflets are not tied with silken threads. It is caused by a toxin injected during oviposition, begins some days before the eggs hatch, and occurs even when they fail to do so. Standard roses are less

susceptible than bush and climbing forms, and varieties with thick, shiny leaves are not attractive to the ovipositing females.

The adults emerge in May and early June, and the females insert their eggs into the marginal tissue of the unfolding leaves. The larvae feed within the rolled leaflets and become fully fed in July and August, when they enter the soil and construct cocoons of soil particles a few inches below the surface. They pupate in February, March or early April. The adults fly actively, but do not travel far, and infestation spreads slowly.

The roots of roses that are being transplanted should be washed to remove any cocoons in the soil adhering to them. For the control of light infestations, rolled leaves should be promptly removed and burned during May and early June; the sawfly has been eradicated in some rose gardens where this has been done in two successive seasons. The generally recommended sprays of lead arsenate or nicotine and soap are ineffective owing to the inaccessibility of the larvae and of the leaf tissue on which they feed. A dust containing 3–4 per cent. nicotine applied at air temperatures above 65°F. is of some value against the larvae, but the inert carrier is not repellent to the ovipositing females. In tests, timely applications of a spray containing 0·1–0·2 per cent. DDT as an emulsified solution killed the adults hovering over and settling on the foliage and a 5 per cent. DDT dust not only killed the adults that were hit by it or alighted on dusted foliage but also prevented oviposition. A second application of the dust after an interval of 7–10 days is necessary to protect the leaves that develop after the first.

FERRIÈRE (C.). **Les espèces européennes du genre** *Elasmus* **Westw. (Hym. Chalc.).**—*Mitt. schweiz. ent. Ges.* **20** pt. 6 pp. 565–580, 4 figs., 17 refs. Berne, 1947.

Following his work on the African and Asiatic species of *Elasmus* [*R.A.E.*, A **18** 198] the author carried out a detailed study of the European species. He redescribes the genus and gives brief notes on its habits as recorded by European workers and a key to the 13 European species that he recognises, of which 8 are new. This is followed by descriptions of the 13 species, with records of the localities in which they were obtained and, with three exceptions, their hosts. They include *E. flabellatus*, Boy., for which the author accepts Masi's interpretation (1907), the type having been lost, and which is recorded from *Prays oleellus*, F., on olive and *Polychrosis botrana*, Schiff., on grape vine, both in Italy; *E. albipennis*, Thoms., which is the hyperparasite of *Hyponomeuta padellus malinellus*, Zell., recorded from Serbia as *E. flabellatus* [**20** 260] and which has also been reared from *Psammotis hyalinalis*, Hb., in Serbia, *H. p. malinellus* in the Ukraine, *Anthophila* (*Simaethis*) *pariana*, Cl., in France, and *Apanteles* sp. parasitising *Enarmonia* (*Semasia*) *rufimitrana*, H.-S., in Poland; *E. viridiceps*, Thoms., which was reared in France from *Goniozus claripennis*, Först., a parasite of *Sparganothis pilleriana*, Schiff.; *E. phthorimaeae*, sp. n., from *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., in Cyprus; and *E. vibicellae*, sp. n., from cases of *Coleophora vibicella*, Hb., probably in Germany, and cocoons of *Galleria mellonella*, L., in Bulgaria.

CALDWELL (N. E. H.). **Codling Moth Control Experiments, 1945–47.**—*Qd J. agric. Sci.* **5** no. 2 pp. 61–76. Brisbane, 1948.

The main features of this account of tests of sprays against *Cydia pomonella*, L., on apple in Queensland in 1945–47, in which DDT was used in two seasons and zinc fluoarsenate in the second, have been noticed from other sources [*R.A.E.*, A **35** 246; **36** 180]. An emulsified solution of benzene hexachloride was also tested in the first season, at concentrations giving 0·013 per cent.

γ isomer in the first two cover sprays and 0·025 per cent. in subsequent ones, but it gave very poor results.

ROBERTSON (P. L.). **Tyroglyphid Mites in Stored Products in New Zealand.**— *Trans. roy. Soc. N.Z.* **76** pt. 2 pp. 185–207, 12 pls., 1 graph, 45 refs. Wellington, N.Z., 1946.

Surveys carried out in the course of investigations on the infestation of cheese by Tyroglyphid and Glycyphagid mites in New Zealand, some of the results of which have already been noticed [*R.A.E.*, A **33** 77, 130; **36** 416; **37** 16], showed that the mites are widespread and are also of importance in causing the deterioration of other stored products. The conditions under which produce is stored in New Zealand are outlined. Stores for grain and commodities other than cheese have no temperature control, air conditioning, or insulation against fluctuations in the outside temperatures, and many could not be adequately sealed for fumigation. Infestation is commonest in summer and early autumn, and develops particularly in neglected material stored for a long period. Flour, bran and pearl barley are the commodities most readily attacked. Reasonably uniform temperatures (50–60°F.) and humidities are maintained in the curing rooms of most cheese factories, and these provide highly favourable conditions for mite increase, which is further favoured by the dim lighting in curing rooms. Each year, the shelves are removed and cleaned by being scraped and scrubbed with caustic soda and are sometimes also dusted with sulphur to destroy mould; the sulphur does not appear to be effective against mites, and the cleaning does not control those sheltering in cracks in the shelves or the supporting uprights. It is therefore suggested that both shelves and uprights should be scrubbed with strong disinfectant each year and that the curing rooms should be fumigated while they are empty. The practice of storing reject cheese in the curing room is probably the most important single factor responsible for infestation and should be discontinued. Cheddar cheese is practically the only type made. That for local consumption remains in the curing rooms for three or four months, or longer if it is to be processed, and always becomes infested. Cheese for export remains in the curing room for two or three weeks and is then transferred to cool stores, where the development of mites transferred with it is retarded so that they do not there become of importance; heavy infestations can occur, however, when the cheese is taken out of cool storage.

Systems of classifying Tyroglyphoid mites published during the present century are briefly discussed, and that of Zakhvatkin [**30** 416] followed. Ten species, all cosmopolitan, are recorded as pests of stored products in New Zealand. The five that infest cheese are a species of *Tyrophagus* referred to as *T. longior*, Gerv., which is the most important [**36** 416] and has also attacked stored wool, dead insects, cultures of fungi and various food substances; *Tyrolichus casei*, Oudm., which is next in importance and appears to be confined to cheese, though it was found on one occasion in small numbers on calf meal; *Tyroglyphus farinae*, Deg., which has attacked cheese in cool storage, processed cheese at room temperature, vells, ergot, seeds of crucifers and flax, pearl barley, unhusked barley, flour, dairy meal, linseed meal, bran and wheat; *Glycyphagus domesticus*, Deg., which attacks cheese in cool storage and, to a lesser extent, at normal temperatures [**36** 416], has also been recorded from pearl barley, and occurred in the greatest numbers yet recorded on vells in cool storage; and *G. destructor*, Schr., which is frequently associated with, though less numerous than, *G. domesticus*, and has also been found in barley, rice, and vells. The other five are *Rhizoglyphus echinopus*, Fum. & Rob., which was recorded from tulip and *Narcissus* bulbs, *Gladiolus* corms, and the decayed stems of Californian thistle [*Carduus arvensis*]; *Thyreophagus*

entomophagus, Lab., which was found in large numbers in flour originally infested by *Tyroglyphus farinae* and in ergot ; *Chortoglyphus arcuatus*, Troup., which was abundant in red clover seed in store at Nelson ; *Gohieria fusca*, Oudm., which was several times recorded from flour and from grain and meal sweepings, generally in association with *T. farinae* ; and a species of *Tyrolichus* tentatively identified as *T. lini*, Oudm., which was found in large numbers on old linseed infested earlier by *Tyroglyphus farinae*. A key, based on one by Zakhvatkin [**30** 416], is given to the families, subfamilies and tribes of Tyroglyphoids and the ten species recorded from New Zealand.

Ullyett (G. C.). **Mortality Factors in Populations of *Plutella maculipennis* Curtis (Tineidae : Lep.), and their Relation to the Problem of Control.**— *Ent. Mem. Dep. Agric. S. Afr.* **2** pt. 6 pp. [1+] ii, 77–202, 30 figs., 3¾ pp. refs. Pretoria, 1947.

The author presents data obtained in the course of six years' work on the biotic complex surrounding *Plutella maculipennis*, Curt., on cabbage in the Transvaal [*cf. R.A.E.*, A **31** 296 ; **32** 87–88, 432 ; **37** 266], and discusses them with reference to the adverse effects produced by the indiscriminate artificial control of insect pests and the desirability of substituting control on a biological basis. *Plutella* develops continuously throughout the year in that region, and climate is not a limiting factor. Continuous records of field populations showed that there was rarely any tendency towards the maintenance of a state of balance between *Plutella* and its natural control agents, since the environment, while remaining favourable to all the biotic elements present, changed sufficiently to enable others to enter or to exert a differential effect on those already present, causing the establishment of new sets of population fluctuations. Further temporary changes were caused by catastrophic factors that occurred sporadically or periodically, usually as a result of physical changes in the environment. Parasites constitute the most important natural control agents of *Plutella*, and 14 primary parasites were found to be involved ; they comprised a Tachinid (probably *Cadurcia plutellae*, van Emd. [**31** 156]) and a Nematode that attack the larvae and 12 Hymenoptera, of which eight parasitise the larvae and four the pupae. Those that have been identified are *Apanteles halfordi*, Ullyett, *A. ruficrus*, Hal., *Bracon* (*Microbracon*) *hebetor*, Say, and *Chelonus ritchei*, Wlkn., all of which attack the larvae ; the others include two species of *Angitia*, *Itoplectis* sp., and a species of *Tetrastichus* near *sokolowskii*, Kurdj., on the larvae, and *Stomatoceras* sp., *Brachymeria* sp. and *Thyracella* sp., on the pupae. There are several hyperparasites, but their effect on total parasitism is negligible. Notes on the bionomics of the parasites are given. Adequate natural control would probably be impossible without the assistance of predators, of which Staphylinid beetles, followed by Syrphids and an Anthocorid that normally attacks Aphids, are the most important. The fungus, *Entomophthora sphaerosperma*, and two bacterial diseases give temporary control under suitable climatic conditions, but the weather rarely has any direct effect on populations of *Plutella*, and no mortality due to competition for food occurred during the period under investigation.

In a discussion of total mortality of *Plutella*, it is pointed out that very low mortality due to any one factor should not be ignored, since it may increase control to a significant point. Total mortality was found to be correlated with host density under normal conditions, and hence is probably due largely to biotic factors [*cf.* **24** 159] ; the dependence of parasites and predators on the population density of the species they attack tends to maintain a state of balance in which the latter fluctuates more or less regularly about a mean until a disruptive factor intervenes. Parasitism is the most permanent natural control agent of *Plutella* and is potentially highly effective, but it may be so

modified by other factors as to become almost negligible. These factors comprise increases and decreases in the host populations or the other permanent agents of natural control, the influence of climatic conditions on the crops, host and other members of the complex, the periodical migrations of parasites to other host species, seasonal differences in the attractiveness of the environment to the parasites, and peculiarities in the parasites themselves, such as their ability to seek and recognise suitable hosts and the extent to which they avoid superparasitism and multiple parasitism. It is pointed out that the adverse effects of superparasitism could be minimised in biological control campaigns by liberating parasites when the surface area of the food-plant of the hosts is least suitable for superparasitism [**32** 87] and applying supplementary artificial control measures when it is most suitable. Furthermore, manipulation or treatment of the environment should aim at establishing the ratio between host and parasites at a point that is least favourable for superparasitism.

Mortality due to predators is periodic and greater towards the end of any one breeding season than at the beginning, and its increase depends on factors outside the complex. Total mortality of *Plutella* increases markedly when predators that are nearly always present on or near cabbage plants are most abundant and when those that normally feed on Aphids are forced to seek other food. Mortality due to Staphylinids is reduced by clean cultivation. Birds exert little influence on populations of *Plutella*. Although predators affect parasites adversely, both by destroying parasitised hosts and by reducing the host population, it was found that they could replace them in control.

The disease caused by *E. sphaerosperma* was found to be a catastrophic factor, since the very high mortality caused by it was indirectly responsible for high mortality among the parasites and predators [*cf.* **31** 296] ; *Plutella* was therefore able to increase rapidly when climatic conditions became unfavourable for the fungus and caused extensive damage to the crop. These violent fluctuations, which are characteristic of catastrophic mortality, are usually damped, since weather conditions suitable for the disease occur only irregularly and may not occur at all. Where the climate permits the disease to become a permanent factor, it becomes a controlling agent of great importance, since it can maintain the host population at a low level and is independent of host density. Chemical and mechanical control measures are also regarded as catastrophic factors. A survey of the general literature indicates that these measures are usually harmful to predators and parasites of pests and that infestation in treated crops rapidly becomes greater, after the initial decrease, than in untreated ones. Evidence for the immunity of parasites and predators is scanty and has sometimes been proved false, and insecticides may destroy the natural enemies of pests that had hitherto been of secondary importance and enable them to become injurious. Evidence is reviewed showing that artificial control measures applied to give temporary protection can be timed to cause the minimum amount of harm to the natural enemies of the host, or even to favour them. In experiments during the investigations, sprays of lead arsenate applied against the larvae of *Plutella* resulted in very significant ultimate increases in the pest population.

The paper ends with a list of 20 concepts, concerned mainly with total mortality in host insects, for use in developing a more rational treatment of the problem of control, and suggestions for the control of *Plutella* in the Transvaal. In order to destroy the larvae when neither they nor their natural enemies are likely to be numerous, seedling cabbages should be dipped in a lead-arsenate mixture [**32** 432] before being transplanted. A close watch should be kept for any unusual increase in the populations of *Plutella* or Aphids on the crop, and sprays applied to local infestations that appear to be becoming unmanageable. Irrigation should be carefully performed by means of channels

in the soil, and floor irrigation should be avoided in order to conserve Staphylinid beetles ; dead leaves, weeds and other débris should be allowed to remain on the ground to encourage predators. To maintain a reservoir of parasites, surplus seedlings should be left undisturbed in the seed-bed for as long as possible, overlapping crops of cabbage should be grown throughout the year, cruciferous weeds round the field should not be removed, and watercress should be grown in the irrigation furrows. Larvae of *Plutella* attacked by *Entomophthora* should be looked for after rain, and if they are observed, the crops should immediately be dusted with sulphur to destroy the fungus. The use of insecticides in growing crops should be avoided as much as possible and should not be left until the pest has reached epidemic proportions, when parasites and predators would also be destroyed just as they were becoming sufficiently numerous to exert control.

STRINGER (A.). **A Note on the Resistance of *Solanum polyadenium* to Aphids.**—*Rep. agric. hort. Res. Sta. Bristol 1946* pp. 88–89, 1 pl., 1 ref. Bath [1947].

Species of *Solanum* collected in South America for use in potato-breeding experiments in Britain included *S. polyadenium*, which is known to escape infestation by Aphids [*cf. R.A.E.*, A **35** 97]. In August 1946, potato leaflets heavily infested by *Myzus persicae*, Sulz., were placed on plants of *S. polyadenium* raised at Long Ashton. The Aphids migrated to the plants, but did not become established on them. They were not observed to feed, and their movements were impeded by a black, gummy substance, in which glandular hairs were subsequently found to be embedded, that accumulated on their tarsi. The leaves of *S. polyadenium* bear numerous glandular hairs, and tests demonstrated the presence of a free, oily substance on the leaf surface. J. B. Adams, in the United States, was able to establish limited infestation of *M. persicae* on the stolons of *S. polyadenium*, which are apparently free from oil, and accordingly suggested that this may be repellent ; she quoted work by Sleesman in which plants of *S. polyadenium*, which is not normally attacked by leafhoppers [*cf.* **30** 74], became infested by them after being washed with strong soap solution. It is here suggested that the immunity of mature leaves of *S. polyadenium* from attack by Aphids is due to a repellent action of the free oil and the mechanical action of the gummy secretion in preventing the Aphids from feeding.

SOUTHEY (J. F.). **A preliminary Survey of the Insects associated with Hops in the West Midlands in 1946.**—*Rep. agric. hort. Res. Sta. Bristol 1946* pp. 112–116, 6 refs. Bath [1947].

A survey of hop-yards in the West Midlands of England was made during April–August 1946 to obtain information on insects that might be concerned in the transmission of virus diseases of hops. Detailed observations were made in Herefordshire, and some farms in Worcestershire were also visited. Adults of *Psylliodes attenuata*, Koch, which were abundant and feeding actively on nettle (*Urtica dioica*) in the hedgerows early in April, assembled on the hops about 10th April, when the young leaves were beginning to open, and spread rapidly, though the damage was not sufficient to warrant control measures. They were most numerous during the first half of May and had become scarce by the end of June. Small numbers of *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) were observed in April on young bines at one farm ; this Aphid was recorded on hops at this season in previous years, but the extent of its distribution is not known. *Phorodon humuli*, Schr., was present on sloe [*Prunus spinosa*], bullace [*P. insititia*] and plum in and near the hedges surrounding hop-yards at the beginning of May, migrated to hops during the second week of that month, increased rapidly until routine dusting with nicotine

was begun in June, and then persisted in small, roughly constant numbers. The nicotine dust was the chief control agent, but natural enemies, of which *Adalia* (*Coccinella*) *bipunctata*, L., was the most important, played an appreciable part. Other predators included *Coccinella septempunctata*, L., *Propylea* (*C.*) *quatuordecimpunctata*, L., *Halyzia 14-guttata*, L. [*sic* ? *sexdecimguttata*, L.], *Anthocoris nemoralis*, F., *Malthodes minimus*, L., and the larvae of a Syrphid ; Braconid parasites and ectoparasitic red mites were also present. The natural enemies gradually increased during June and remained numerous for some time after the Aphids had been controlled by insecticides, but decreased towards the end of July. *Thrips fuscipennis*, Hal., was fairly common and widespread from mid-May to the end of August ; it occurred on the young leaves and stipules near the tips of the shoots, on the under sides of the leaves and, later, in the hop cones, but was not sufficiently abundant to be injurious. First-instar nymphs of Mirids and Jassids appeared early in May. Nymphs of *Lygus pabulinus*, L., were common and presumably hatched in April from eggs laid in the crowns of the stocks in the previous year. They left the hops early in June, before their final moult, and adults were common shortly afterwards on nettles and other hedgerow weeds. No eggs were found. Insects that occurred occasionally on the bines included species of *Typhlocyba* and *Empoasca* (*Chlorita*), which were present from May onwards, *Cercopis* (*Triecphora*) *vulnerata*, Ill., a few adults of which were found feeding on the leaves of hops near hedgerows, in which it was common, about the middle of May, and *Crepidodera* (*Chalcoides*) *aurata*, Marsh., adults of which fed in numbers on hop leaves in one hop-yard about the middle of May and had evidently migrated from willow, the usual food-plant. Species found in the cones were *Thrips fuscipennis*, which was the commonest, *P. humuli*, nymphs of *Anthocoris* sp. that preyed on it, *Adalia bipunctata* and a mite.

Many of the hop-yards were surrounded by a belt of rough grass with nettles, behind which was usually a tall wind-break, often of elm. Nettle and elm may both serve as alternative food-plants for pests of hops, and it is possible that they may be symptomless hosts of hop virus diseases. *Psylliodes attenuata* and *L. pabulinus*, which pass part of their life-cycle on nettle, were both observed also feeding on elm. It is suggested that pest incidence might be reduced if hawthorn [*Crataegus*] was used in windbreaks instead of elm or sloe, and nettles and other weeds checked.

Nettlehead and mosaic are the most important virus diseases of hops, and the former is probably the chief cause of losses in the area. Their mode of transmission is not known, but of the insects belonging to orders concerned with the transmission of plant viruses, those with a distribution that could account for the incidence and spread of the diseases are *Thrips fuscipennis*, *Phorodon humuli*, *Macrosiphum solanifolii*, *Lygus pabulinus* and *Psylliodes attenuata*. Tests by A. M. Massee with *T. fuscipennis*, *P. attenuata* and *Phorodon humuli* gave negative results.

Petersen (H. I.) & Stapel (C.). **Afprøvning af kemiske Bekaempelsesmidler mod Plantesygdomme og Skadedyr. II.** [Tests of chemical Control Measures against Diseases and Pests of Plants. II.]—*Tidsskr. Planteavl* **51** pp. 136–146, 3 graphs ; also as *Beretn. Forsøgsv. PlKult.* no. 402. Copenhagen, 1947. (With a Summary in English.)

In further tests in Denmark [*cf. R.A.E.*, A **34** 7], proprietary preparations of DDT and others of unstated composition were tested against various insects in 1944–45. In field tests on crucifers against adults of *Meligethes aeneus*, F., Gesarol powder and Idosect powder (each containing 5 per cent. DDT) both gave complete or almost complete control 2–3 days after application at 18 lb. per acre, and Idosect kept the population at a low level for five but not eight

days. Both were fairly effective at 9 lb. per acre. In a laboratory test, the toxicity of Gesarol to the beetles was not affected by high or low temperature (24–29 and 8–11°C. [75·2–84·2 and 46·4–51·8°F.]), whereas that of a derris dust [*loc. cit.*] was reduced at the low temperature. When used against *Phyllotreta* spp. in the field, Gesarol gave very high control at 18 lb. per acre, and was still sufficiently effective at 9 lb. When beetles were dusted in a bell-jar and transferred to untreated food, Gesarol at the rate of 0·015 oz. per sq. yard gave complete knockdown in 14 hours. Both DDT dusts at 27 lb. per acre gave high control of adults of *Byturus urbanus*, Lind. (*tomentosus*, auct.) on raspberry and maintained it for a week. When tested in the laboratory in the same way as on *Phyllotreta*, Gesarol and Idosect gave 96·4 and 100 per cent. knockdown, respectively, in three days at 0·0075 oz. per sq. yard. Gesarol at 13·5 and 27 lb. per acre reduced the percentage of strawberry flowers injured by *Anthonomus rubi*, Hbst., by more than half, and there was little difference between the two rates. For practical control, two applications would probably be necessary. A Gesarol spray was almost as effective. Gesarol powder and spray gave almost complete control of larvae of *Pieris brassicae*, L., on cabbage and brussels sprouts in a day.

Butovitsch (V.). **Redogörelse för flygbekämpningskampanjen mot tallmätaren under åren 1944–1945.** [Report of the Aerial Control Campaign against *Bupalus piniarius* in 1944–45.]—*Medd. Skogsforskningsinst.* **35** no. 9, 108 pp., 39 figs., 36 refs. Stockholm, 1947 (preprint 1946). (With a Summary in German.)

The following is based on the author's summary. *Bupalus piniarius*, L., was very injurious in pine forests in central and southern Sweden in 1943. In 1944, four heavily infested areas were dusted with Gesarol (5 per cent. DDT) from a seaplane specially adapted for the purpose. The results were estimated by spreading sheets beneath the trees before and after dusting to catch the excreta of the larvae and examining the trees and sampling the forest floor for pupae in the following spring. The first area was dusted in rather windy weather in late August at an average rate of 6·4 lb. Gesarol per acre. The mortality of larvae averaged 96 per cent. over the whole of the area, but was as low as 50 per cent. in parts of it dusted under unfavourable conditions. Examination in the spring of 1945 showed that infestation had persisted in these parts, though damage had been light in most of them, and that the pupal population was extremely low in parts dusted under favourable conditions and fairly high in the others, though there was an increase in the percentage parasitised and diseased. The area was re-dusted at the same rate in August 1945 from an aeroplane. Wet weather prevented the collection of excreta, but no further damage to the trees was reported that autumn.

The second area was dusted in early September 1944 at 7·5 lb. per acre, in favourable weather, though rain fell six hours later. Mortality of larvae averaged 81 per cent., and except in two small places, no evidence of further feeding could be observed in the spring of 1945. Pupae were rare, and were absent over most of the area, and there was no serious feeding in 1945. The other two areas were also dusted in September, the first at 6·75 lb. per acre, and the second, in which infestation was less heavy, at half the rate. Rain fell shortly after in both places, but little feeding occurred during the rest of the year.

No injury to birds, mammals or honey bees was observed in any dusted area, even though a bee colony was specially installed in one of them.

Trees in all the areas were infested by bark-beetles of the genus *Myelophilus* in proportion to the damage caused to them by *Bupalus*; infestation by

bark-beetles declined in the last two areas in 1945, corresponding to the good control of *Bupalus* and the consequent recovery of the trees, but increased in the first, where *Bupalus* persisted.

JOHANSSON (E.). **Studier och försök rörande de på gräs och sädesslag levande tripsarnas biologi och skadegörelse. II. Tripsarnas frekvens och spridning i jämförelse med andra sugande insekters samt deras fröskadegörande betydelse.** [Studies on the Biology of Thysanoptera that live on Grass and Cereals and the Injury caused by them. II. The Frequency and Spread of Thysanoptera in Comparison with other Sucking Insects and their Importance in injuring the Seed.]—*Medd. Växtskyddsanst.* no. 46, 59 pp., 14 figs., 10 refs. Stockholm, 1946. (With a Summary in English.)

An account is given of further observations on the injury caused by thrips to cereals and pasture grasses in Sweden [*cf. R.A.E.*, A **27** 121], with special reference to the spread of infestation and its effect on the seed. Some attention was also paid to other sucking insects.

The following is based largely on the author's summary. The species of thrips chiefly responsible for injury are *Haplothrips aculeatus*, F., which was the commonest on wheat and grasses, *Anaphothrips obscurus*, Müll., and *Limothrips denticornis*, Hal., which were commonest on barley and rye, and *Chirothrips manicatus*, Hal., and *C. hamatus*, Tryb., which were generally distributed. The adults are spread by air currents, and the numbers counted on adhesive traps placed at various heights up to about 50 ft. above the ground in 1934 and 1935 were greatest at about 19°C. [66·2°F.] and at 70–75 per cent. relative humidity. There was a better correlation with temperature than with humidity, but much the closest correlation was with a value termed the humidity ratio, obtained by dividing the percentage relative humidity by the pressure (in mm.) of evaporation from the surface of the ground. The numbers taken at all heights were greatest when this value was 11–13. There was no constant relation between the numbers taken at the different heights.

Infestation causes considerable injury to the seed. The species of *Chirothrips* are chiefly responsible for this on the grasses, the percentage of kernels of timothy [*Phleum pratense*] injured by it being 11–19. The corresponding percentage for all species on cereals varied greatly, that for barley averaging 17 in 1943 and 0·2 in 1934, and that for wheat 6·4 in 1943. The reduction in viability of the seeds also varied greatly, with considerable varietal differences, but averaged about 10 for injured kernels of all crops. Injured seeds also lost weight, but there was no clear relation between injury and loss of germinating power. By staining injured wheat seeds in various ways, a positive relation was found to exist between germinating power and the content of ferments.

Lists are given of the other sucking insects (Jassids and Pentatomids) taken in pasture grasses, with notes on their importance on these and on wheat and barley. On barley, they injured 9 and 2·8 per cent. of the kernels in 1943 and 1944, respectively, and on wheat, 5·6 per cent. in 1943.

TUNBLAD (B.). **Giftkli mot jordflylarver i plantskola.** [Poison Bran against Cutworms in a Nursery.]—*Växtskyddsnotiser* 1947 no. 4 pp. 53–55, 1 fig. Stockholm, 1947.

A bait consisting of wheat bran, Cryocide [cryolite], sugar and water (50 : 3 : 2 : 40) gave over 90 per cent. mortality of larvae of *Agrotis segetum*, Schiff., attacking the young stocks of apple and other fruit trees in a nursery in Sweden in 1947. It was distributed along the rows in the evening, and dead and dying larvae surrounded the plants the next morning.

Mathlein (R.). **Långtidsverkan av DDT-preparat mot skadedjur i spannmålslager.** [Prolonged Action of a DDT Preparation against Pests in Stored Grain.]—*Växtskyddsnotiser* 1947 no. 4 pp. 60–62. Stockholm, 1947.

In the tests described, 0·1 and 0·2 per cent. by weight of a DDT powder known as Geigy 33 [*cf. R.A.E.*, A **36** 134, etc.] were mixed with lots of 500 gm. wheat, and 300 adults of *Calandra granaria*, L., added to each. All the weevils were dead after 19 days. In a similar test with *C. oryzae*, L., the two treatments gave complete mortality after 11 and 8 days, respectively. The weevils were then removed in both series, and the wheat kept at room temperature to see whether oviposition had occurred. After four months, no adults of *C. oryzae* had emerged, and only 1–4 per jar of *C. granaria*, all of which were dead. The wheat was again infested with *C. granaria* 14 months later, and 78 and 98 per cent. of these died in 36 days. All were dead at 97 days, but a few new adults had emerged, though most of these were then also dead. After 260 days, there were no living weevils and the wheat was practically undamaged. Nearly two years after the original treatment, when no trace of the powder could be seen in the wheat, as a result of the repeated sifting, further weevils were introduced into it. All were dead 2·5 months later. Some new adults had emerged after a further month, but 70–80 per cent. were dead. Only one survived after another two months for the treatment at the lower rate, and none for the higher.

A similar test with benzene hexachloride showed that protection was unsatisfactory after three months ; the wheat was kept uncovered.

Borg (Å.). **En skadeinsekt på primula.** [An Insect Pest of Primula.]—*Växtskyddsnotiser* 1947 no. 4 pp. 62–64, 2 figs. Stockholm, 1947.

Larvae of *Aristotelia* (*Monochroa*) *farinosae*, Staint., are recorded feeding on the leaves and flower buds of primula (*Primula veris*) in a commercial garden at Lund, Sweden. This Tineid normally feeds on wild *P. farinosa* and *P. veris* and has not previously been cited as a pest.

Borg (Å.). **Om blodlusens övervintring 1946–1947.** [The Overwintering of *Eriosoma lanigerum* in 1946–47.]—*Växtskyddsnotiser* 1947 no. 6 pp. 81–85, 1 graph. Stockholm, 1947.

Advantage was taken of the severe winter of 1946–47 in Sweden to study the survival of overwintering examples of *Eriosoma lanigerum*, Hsm., on the aerial parts of apple trees [*cf. R.A.E.*, A **31** 321] and of its parasite, *Aphelinus mali*, Hald. The Aphid overwinters chiefly in the nymphal stage, most of the adults dying off, together with any parasite larvae in them that have not reached the last instar, but parasites that have killed their hosts survive in the dead bodies in the larval or pupal stage until spring, thus increasing winter survival. Samples of Aphids were taken from colonies on the stems and branches of apple trees in two southern localities on various dates between February and July 1947 and examined for mortality, and parasitised examples were incubated to ascertain the parasite survival. The temperature fell to −18·5°C. [−1·3°F.] during March. The results showed that the Aphids were so severely reduced by the cold that no adults and very few nymphs were alive in samples taken at the end of March and none at all in those taken in April or May. Living Aphids were not found until June, when small new colonies occurred on the trees, and infestation did not become general until August, after which it was severe. The percentage parasitism remained about 25–35 throughout the winter and spring, and the percentage of parasites that emerged was almost constantly 67 ; the method of incubation is thought to have been responsible for the

lowness of this figure. The percentage parasitism fell off in May and June and increased in July in the new Aphid colonies. The cold thus appeared to have had no effect on the parasite.

Schwan (B.) & Wahlin (B.). **Några försök med DDT och bin.** [Some Experiments with DDT and Bees.]—*Växtskyddsnotiser* 1947 no. 6 pp. 88–92. Stockholm, 1947.

In view of complaints in Sweden of honey bees being poisoned by DDT used for the control of *Meligethes aeneus*, F., on rape, several tests were carried out in which bee colonies were caged on flowering rape either before or after it was dusted or sprayed with proprietary forms of the insecticide. The results showed that the bees were not affected unless they were actually on the rape at the time of treatment, when mortality of workers was high, though even then the queen and young brood were not affected. Although no injury would be caused by treating flowering rape or similar crops during the absence of bees, it is thought safer to avoid treating them during flowering.

Borg (Å.). **Ett angrepp av majsmottet på humle.** [An Attack by *Pyrausta nubilalis* on Hops.]—*Växtskyddsnotiser* 1947 no. 6 pp. 93–94. Stockholm, 1947.

Occasional examples of *Pyrausta nubilalis*, Hb., are taken in southern Sweden, but there are no records of its being a pest there. In October 1947, however, larvae were found boring in the stems of hops. It is not known whether they would survive the winter, and it is thought unlikely that the moth could become established on a large scale, because of the cold.

Tunblad (B.). **Ett bekämpningsförsök mot växthusgräshoppa.** [An Experiment on the Control of the Greenhouse Grasshopper.]—*Växtskyddsnotiser* 1947 no. 6 pp. 94–96, 1 fig. Stockholm, 1947.

The Gryllacrid, *Tachycines asynamorus*, Adel., is an occasional pest in greenhouses in Sweden, where it feeds at night on the leaves, petioles and peduncles of ornamental plants, especially *Cyclamen*, *Adiantum* and *Chrysanthemum*, and is difficult to control. In tests, DDT proved useless, but proprietary dusts containing benzene hexachloride and chlordan both gave very high mortality. It is thought that a second application would be necessary to kill individuals hatching from eggs present in the soil.

Paoli (G.) & Boselli (F.). **Introduzione di oofagi del *Dociostaurus maroccanus* Thnb. dalla penisola italiana in Sardegna.** [Introduction of Egg-parasites of *D. maroccanus* into Sardinia from peninsular Italy.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 21–40, 16 figs., 5 refs. Genoa, 1947.

In view of the increasing injury by *Dociostaurus maroccanus*, Thnb., in Sardinia, it was decided in 1946 to introduce the Meloid, *Mylabris variabilis*, Pall., and the Bombyliids, *Cytherea obscura*, F., and *Systoechus ctenopterus*, Mikan, from the Italian mainland, where their larvae give important control of the locust by feeding on its eggs within the pods. Notes on their bionomics are given based on a paper already noticed [*R.A.E.*, A **26** 163]; all three are widely distributed, but do not occur in Sardinia. Adults of *Mylabris* were collected in July, when the females contained mature eggs, and 21,000 were sent to Sardinia in cages. Few died on the way, and the rest were released near flowering plants in 22 localities where the locust was known to have oviposited within the week. Some were destroyed in one place by the Tettigoniid, *Uromenus insularis*, Chopard. Larvae of the two Bombyliids, which were not

distinguished from each other, were collected in late August, the majority in egg-pods and a few free in the soil, and an estimated total of nearly 14,000 full-fed larvae of the two species were sent to Sardinia and released at six places where the locust was known to breed. The egg-pods were covered with soil, and the free larvae were placed on prepared ground in the soil in which they had been transported and covered with brushwood to protect them from birds. Further larvae were introduced in November. Operations were then suspended for the year, but larvae of the Bombyliids were found alive at one place in March 1947, having apparently survived the winter in good condition.

Binaghi (G.). **Nuovi mezzi di lotta contro la processionaria dei pini (*Thaumetopoea pityocampa* Schiff. Lep. Thaum.).** [New Methods of Controlling the Pine Processionary, *T. pityocampa*.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 41–47, 2 figs. Genoa, 1947.

Considerable injury has been caused by *Thaumetopoea pityocampa*, Schiff., to plantations of *Pinus nigra* established during the last ten years on the bare slopes of the Apennines near Genoa, and a method of control was desired that would not involve cutting off the branches bearing the nests of the larvae, which is the usual measure but would have damaged the trees irreparably. In preliminary tests, nests were taken to the laboratory, and 5 or 10 cc. of a commercial solution of DDT in kerosene (concentration unstated) or kerosene alone was injected into them by means of a hypodermic syringe. The DDT solution gave complete or nearly complete mortality of the larvae in three days, and was superior to kerosene alone, though the latter also gave complete mortality at the higher rate. Nests in the field were then treated with 10 cc. DDT solution or 5 or 10 cc. kerosene, and on examination four days later, DDT was found to have killed all the larvae in two nests and nearly all in another, while kerosene did not give complete mortality in any case.

In view of the high cost of DDT, solutions of 1, 2 and 5 per cent. paradichlorbenzene in kerosene were tested by the same method at 10 cc. per nest. On the following day, the 5 per cent. solution had killed all the larvae, while the two others both permitted some survivors. A further test with 5 per cent. paradichlorbenzene gave the same result. Observations after a month showed that none of the treatments had injured the trees.

Gambaro (P.). **Il ciclo biologico dell'*Aspidiotus perniciosus* Comst. nel Veronese.** [The Life-cycle of *Quadraspidiotus perniciosus* in the District of Verona.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 48–58, 2 figs., 8 refs. Genoa, 1947.

An account is given of observations on the seasonal development of *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., on apple in the district of Verona in 1944–45, and the results are compared with those obtained by Melis in Tuscany [*R.A.E.*, A **36** 64], from which they differed somewhat. The only stage to survive the winter was the first instar. In 1944, development was resumed in the second half of March, and adult males appeared at the end of April, at which time 70 per cent. of the females had reached sexual maturity. There were three generations in the year, the crawlers appearing in early June, early August and mid-October, but there was some overlapping, owing to the length of the reproductive period (4–5 weeks). In 1945, as a result of warm weather in spring, development was resumed about a fortnight earlier than in 1944, and this advance was maintained throughout the year, though there was no evidence of a fourth generation. The difference in the duration of the generations appeared to be mainly due to differences in the period between fertilisation and the appearance of crawlers, which varied from 28 to 40 days,

depending on temperature ; development up to sexual maturity was almost constant at 35–40 days. It was not possible to determine the sex ratio with any certainty, since it varied with locality, exposure to the sun and the part of the tree considered, males predominating in some situations and females in others.

GRIDELLI (E.). **Che cosa è la carruga o melolonta della vite.** [The Identity of the Vine *Anomala*.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 59–62, 2 figs., 1 ref. Genoa, 1947.

The author states that *Anomala ausonia*, Erichs., has been confused with *A. vitis*, F., in the Italian literature. Both attack grape vines in Italy, but they differ in morphology, distribution and habits. Characters distinguishing the adults are described and figured. *A. vitis* occurs in Venetia as far west as the district of Verona [*cf. R.A.E.*, A **23** 627], except on parts of the Venetian coast, and penetrates into Lombardy and Piedmont, while *A. ausonia* occurs in Sicily and in continental Italy from Calabria to Liguria on the west and also on parts of the Venetian coast. The areas occupied by the two species are thus discontinuous, but they do not overlap at any point. Adults of *A. vitis* are diurnal, those of *A. ausonia* nocturnal. *A. ausonia* was originally described from Sicily, and since examples from southern Italy differ somewhat in coloration, etc., from Sicilian ones, they can be referred to subsp. *neapolitana*, Rtt., but Venetian examples appear to belong to still another subspecies.

JANNONE (G.). **Studi e ricerche di entomologia agraria in Eritrea e in Etiopia. III. Osservazioni su due Ditteri parassiti contemporanei dei frutti di** *Momordica Schimperiana* **(?) Naud. e su un simbionte di uno di essi.** [Studies and Researches in Agricultural Entomology in Eritrea and Abyssinia. III. Observations on two Diptera infesting the Fruits of *M. schimperiana* together and on a Symbiont of one of them.]—*Mem. Soc. ent. ital.* **26** fasc. suppl. pp. 63–69, 9 refs. Genoa, 1947.

In continuation of studies on insects causing the fall of *Citrus* fruits in Eritrea [*R.A.E.*, A **36** 108], the author records the finding in May 1946 of larvae of *Dacus ciliatus*, Lw. (*brevistylus*, Bez.), one of the species concerned, in fallen fruits of a wild cucurbit of the genus *Momordica*, probably *M. schimperiana*, on the lower eastern slopes of that country. They were accompanied in many of the fruits by *Lonchaea laevis*, Bez. Some of the *Dacus* larvae were parasitised by *Tetrastichus* sp., adults of which emerged about five days after their host.

MILLIRON (H. E.). **Description of a new Mymarid which parasitizes the Eggs of the Saratoga Spittlebug.**—*Ann. ent. Soc. Amer.* **40** no. 2 pp. 217–220. Columbus, Ohio, 1947.

The author describes both sexes of *Ooctonus aphrophorae*, sp.n., some adults of which were reared in 1946 from eggs of *Aphrophora saratogensis*, Fitch, collected on dead twigs of red maple [*Acer rubrum*] in Wisconsin, and others swept from jack pine [*Pinus banksiana*] in the neighbourhood. The parasites reared between 7th and 22nd September were from host eggs that had been laid in 1945, and those reared between 22nd September and 12th October from those of 1946. Examination of limited numbers of eggs of *Aphrophora* collected during the third week in September showed 8·5–9·3 per cent. parasitism, and it is considered that samples collected later in September and during October would show higher percentages, and that the parasite may be of considerable economic importance in controlling the Cercopid.

Heal (R. E.) & Menusan jr. (H.). **A Technique for the Bloodstream Injection of Insects and its Application in Tests of certain Insecticides.**—*J. econ. Ent.* **41** no. 4 pp. 535–543, 4 figs., 21 refs. Menasha, Wis., 1948.

The following is based on the authors' introduction and summary. Since new insecticides of high specific or broad activity may be overlooked if tests of their contact or stomach action are restricted to a few species of insects and it is impracticable to maintain a large representative number of species under laboratory conditions throughout the year, and since it was considered that specificity of action was more closely associated with penetration than with any other single factor, injection into the blood-stream of insects as a means of survey for new insecticides was undertaken in 1939 [*cf. R.A.E.*, A **37** 394].

By means of an apparatus designed for the injection of liquids, which is described, a technique for rapid and accurate injection into adults of *Periplaneta americana*, L., was developed. The apparatus was also found suitable for making accurate oral feeding tests and measured-drop contact tests with insecticides. Limits were established for the injection into cockroaches of non-toxic quantities of water, aqueous solutions of certain surface-active agents and water-miscible solvents. The optimum volume of liquid to be injected in the evaluation of insecticides was found to be 0·002–0·004 ml. per 0·1 gm. body weight.

Dosage-mortality curves for sodium arsenate, sodium fluoride, pyrethrins, nicotine and derris extractives were established by injection into *P. americana*, and the toxicities of these compounds by injection were compared with their respective toxicities by stomach-injection and contact. The blood-stream test generally revealed the high toxic value of each compound more positively than either of the other tests, and relatively accurate dosage-mortality values could be established by tests with not more than ten individuals per dosage point. It is concluded that the technique provides an accurate and useful test for surveys of materials of unknown insecticidal value.

Watts (J. G.). **Cotton Insect Control with organic Insecticides.**—*J. econ. Ent.* **41** no. 4 pp. 543–547. Menasha, Wis., 1948.

Experiments on the control of cotton insects were carried out in South Carolina in 1947, when the season was very favourable to the boll-weevil [*Anthonomus grandis*, Boh.], the insecticides being applied in a manner that approximated to large-scale field operations. Dusts were applied with tractor-mounted dusters at the rate of about 8 lb. per acre and a proprietary spray stated to contain 0·5 per cent. lead arsenate, 0·4 per cent. calcium arsenate, 0·13 per cent. pyrethrins and 21 per cent. mineral oil with a horse-drawn tractor sprayer at about 1·25 U.S. gals. concentrate per acre. In a plot experiment in which the insecticides were applied five times between 20th June, when square infestation averaged about 36 per cent., and 7th August, about a fortnight before harvest began, the percentages of squares punctured by *Anthonomus*, the numbers of aphids [*Aphis gossypii*, Glov.] per sq. inch and the yields, in lb. seed cotton per acre, were 47·17, 54·9 and 570·2 for no treatment, 30·78, 19·9 and 1,014·5 for a dust containing 5 per cent. DDT and 3 per cent. γ BHC (benzene hexachloride), 30·72, 23·6 and 913·1 for 4·8 per cent. γ BHC, 36·88, 39·6 and 838·8 for 20 per cent. chlorinated camphene [toxaphene], 38·61, 67·9 and 781·3 for calcium arsenate with 1 per cent. nicotine, and 45·81, 48·6 and 634·3 for the spray concentrate diluted 2 : 23 ; the least differences required for significance were 4·14, 9·99 and 122·98. The bollworm [*Heliothis armigera*, Hb.] was generally unimportant, though it caused limited damage in plots treated with 4·8 per cent. γ B.H.C. Red spiders [*Tetranychus*] were of no importance. In a second test, each of the four dusts was applied to two or

more fields under normal commercial conditions with results that confirmed those of the first test, but their significance was reduced by the very low yield in the controls.

Because of the potential widespread use of chlorinated hydrocarbons on cotton and other crops, it is important to know the extent to which they may accumulate in the soil and become toxic to growing plants. Nineteen different crops were therefore sown in a heavy soil (Grady sandy loam) and a light one (Norfolk sandy loam deep phase) that had been treated the same day with 50 per cent. DDT, 6 per cent. γ BHC or 36 per cent. toxaphene at five different rates (40, 100, 200, 400 and 2,000 lb. per acre). The insecticides were applied by hand in the drill, approximately an inch below the seed. On the heavy soil, there was no apparent injury to any of the crops by any rate of DDT or toxaphene, but all showed light to severe reduction in stand when 6 per cent. γ BHC was used at 2,000 lb. per acre, and all except cowpeas and lima beans showed very light to moderate reduction in stand when it was used at 400 lb. per acre. At 200 lb., it caused a reduction in stand in grain sorghum only, and no injury was apparent on any of the crops in soil treated with 40 or 100 lb. per acre. Even at the higher rates, some of the plants survived and matured normally. An irregular stand of most crops on the light soil made accurate comparisons impossible, but no injury was apparent to any crop at any rate of DDT or toxaphene, though injury from BHC was relatively more severe than on the heavier soil.

Gaines (J. C.) & Dean (H. A.). **Tests of Insecticides for the Control of several Cotton Insects.**—*J. econ. Ent.* **41** no. 4 pp. 548–554, 1 ref. Menasha, Wis., 1948.

Investigations on some of the newer insecticides for the control of *Psallus seriatus*, Reut., *Anthonomus grandis*, Boh., *Heliothis armigera*, Hb., and *Aphis gossypii*, Glov., on cotton were continued in Texas in 1947 [*cf. R.A.E.*, A **37** 149]. The following is based on the authors' summary. The results of three experiments indicated that 1 per cent. parathion or 5 per cent. chlordan in an inert dust and 1 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT and 5 per cent. chlorinated camphene [toxaphene] in sulphur were effective against *P. seriatus* and gave economic increases in yield when applied once in late June [*cf.* **37** 424]. Sulphur alone was less effective. In a factorial experiment destined to afford valid comparisons between different insecticides, acting both as contact and as stomach poisons against all cotton insects, applications of 5 per cent. DDT in sulphur decreased the fleahopper population but did not affect the yield; 20 per cent. toxaphene in sulphur and 3 per cent. γ BHC with 5 per cent. DDT in sulphur gave significantly better control of *H. armigera* and higher yields than calcium arsenate, but all three were equally effective against *Anthonomus* and only calcium arsenate caused increases in the Aphid population. In another test on five-acre plots, the mixture of BHC, DDT and sulphur gave better control than calcium arsenate of *H. armigera*, but not of *A. grandis*. It gave better control of the weevil than 20 per cent. toxaphene in sulphur and resulted in the highest yield. Toxaphene was more effective against *H. armigera* at 20 than at 10 per cent.

In a randomised block experiment, in which *H. armigera* was the primary pest, 20 per cent. toxaphene in sulphur and the mixture of BHC, DDT and sulphur gave significantly better control than 20 per cent. chlordan in an inert dust, or calcium arsenate, which were equally effective, but there were no significant differences between yields. Calcium arsenate was as effective as the organic compounds in sulphur against *A. grandis*, but the organic dusts did not cause increases in the numbers of Aphids. Parathion and BHC were effective in reducing heavy populations of *Aphis gossypii*.

Snapp (O. I.). **Control of Sucking Bugs that cause deformed Peaches.**—*J. econ. Ent.* **41** no. 4 pp. 555–557, 2 figs., 2 refs. Menasha, Wis., 1948.

Further experiments on the use of DDT and BHC (benzene hexachloride) against bugs that cause deformation of peaches were carried out in South Carolina in 1947 [*cf. R.A.E.*, A **36** 235]. In an orchard infested by both *Lygus oblineatus*, Say, and Pentatomids, a spray of 1 lb. DDT micronised in an equal amount of pyrophyllite, with 1 U.S. pint fish-glue solution (1 lb. per U.S. gal. water), per 100 U.S. gals. water reduced the percentage of fruits damaged by the bugs from 17 to 4, 15·4 and 4 when applied at petal-fall, shuck-off and both, 1 lb. DDT combined with a standard spray of 16 lb. of a mixture of lead arsenate, basic zinc sulphate and sulphur and 8 lb. hydrated lime per 100 U.S. gals. directed against the plum curculio [*Conotrachelus nenuphar*, Hbst.] reduced it to 5·2 when applied at petal-fall and shuck-off, and one of 1 lb. powder containing 31·6 per cent. BHC, equivalent to 3·79 per cent. γ isomer, per 100 U.S. gals. reduced it to 8·8, 11·2 and 5·4 when applied at petal-fall, shuck-off and both, respectively. The petal-fall application of DDT was evidently the most important one, and the addition of the curculio spray containing lime did not reduce the effectiveness of the DDT. DDT was somewhat more effective than BHC except when applications were made at shuck-off only, when BHC may have been a little the more effective against Pentatomids, which are generally more active at this time than earlier. However, most of the damage caused to peaches by bugs is due to attacks earlier in the season.

A fog generator was compared with a conventional power sprayer for the application of DDT at petal-fall and shuck-off. The compound was applied at about 1·5 lb. per acre as a fog released from a mixture of 15 lb. DDT, 4 U.S. gals. xylene, 6 U.S. gals. motor oil and 10 U.S. gals. water or as a standard wettable-powder spray of 1 lb. DDT per 100 U.S. gals. alone or with lead arsenate, zinc sulphate and sulphur and gave approximately the same control of bugs by each method. In an untreated plot in one orchard, jarring showed that *L. oblineatus*, other Mirids and Pentatomids were present when about 85 per cent. of the petals had fallen, and *L. oblineatus*, *Brochymena quadripustulata*, F., *Euschistus servus*, Say, *E. tristigmus*, Say, and *Lygaeus bicrucis*, Say, when 50–75 per cent. of the shucks were off. In the untreated block of another orchard, an average of 1·3 Pentatomids (*B. quadripustulata*, *E. tristigmus* and *E. servus*) and Coreids (*Leptoglossus phyllopus*, L., and *L. oppositus*, Say) per tree were caught by jarring when 75 per cent. of the shucks were off, whereas after two applications of DDT fog, only four Pentatomids, one Coreid and one Mirid were taken from 12 trees.

Ewing (K. P.) & Parencia jr. (C. R.). **Control of Boll Weevil and Cotton Aphid with Dusts containing Chlorinated Camphene, Benzene Hexachloride or other new Insecticides.**—*J. econ. Ent.* **41** no. 4 pp. 558–563, 3 refs. Menasha, Wis., 1948.

Most of the following is based on the authors' summary. Several experiments were carried out in Texas in 1947 on the value of some of the newer insecticides against *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., on cotton. In a small-plot experiment at Wharton, the yields of cotton dusted with calcium arsenate and dusts containing 5 per cent. γ BHC (benzene hexachloride), 3 per cent. γ BHC with 5 per cent. DDT, and 20 or 10 per cent. chlorinated camphene [toxaphene] showed no significant differences, but the least weevil control and the lowest yield were obtained from the plots treated with 10 per cent. toxaphene. *A. gossypii* caused no damage in any of the plots, though infestation was increased by the calcium arsenate and reduced by the other dusts.

In five large-scale experiments in the same district, 20 per cent. toxaphene gave slightly better and 10 per cent. toxaphene slightly poorer control of *Anthonomus* than calcium arsenate. The Aphid caused considerable damage in most of the plots dusted with calcium arsenate, but not in those treated with toxaphene. As a result of the combined control of weevils and Aphids, both concentrations of toxaphene resulted in higher yields than did calcium arsenate. In experiments in which the dusted plots were strictly comparable, 20 per cent. toxaphene and calcium arsenate increased the acre yields over no treatment by 539 and 360 lb., respectively, and 10 per cent. toxaphene and calcium arsenate increased them by 494 and 211 lb.

In a small-plot experiment at Waco, where both weevils and fleahoppers [*Psallus seriatus*, Reut.] were injurious, plots dusted with calcium arsenate and 10 and 20 per cent. toxaphene produced significantly more cotton than untreated ones. The toxaphene dusts were significantly better than calcium arsenate, and there was no significant difference in yield between the two concentrations. In a second experiment, in which calcium arsenate, 5 per cent. DDT with 2 or 3 per cent. γ BHC, 3 per cent. γ BHC and 2 per cent. parathion were applied on 9th and 14th July, all treatments significantly reduced infestation by the weevil, but were followed by an outbreak of the bollworm [*Heliothis armigera*, Hb.], so that the yields were less than in the controls. In another test, calcium arsenate, 20 per cent. toxaphene alone and with 1 or 2 per cent. parathion and 10 per cent. toxaphene with 2 per cent. parathion all gave significant control of the weevil, with no significant difference between them, and only calcium arsenate resulted in Aphid increase, but the addition of 2 per cent. parathion to 20 per cent. toxaphene slightly reduced the weevil control given by the latter alone. In a fourth test, dusts of 2 per cent. γ BHC in the regular calcium arsenate or 1 or 2 per cent. in a special calcium arsenate prevented an increase in Aphid infestation over that on untreated plants, whereas 1 per cent. in the regular calcium arsenate allowed it to increase significantly, though calcium arsenate alone increased it much more.

Cockerham (K. L.) & Deen (O. T.). **Insecticide Tests in Field Plots for Control of the Sweetpotato Weevil.**—*J. econ. Ent.* **41** no. 4 pp. 563–565. Menasha, Wis., 1948.

The results are given of experiments carried out in Louisiana in 1938–47 to determine whether field infestations of *Cylas formicarius elegantulus*, Summers, on sweet potato could be effectively and economically controlled with insecticides and if so to develop suitable schedules of applications. The insecticides were applied as dusts, unless otherwise stated. In 1938, basic calcium arsenate was more effective than cryolite, and adhesives did not improve control. Applications at intervals of 14 days throughout the season were significantly better than 2–4 applications early or late in the season, though all were better than no treatment. In 1939, basic calcium arsenate, applied at dosages of 5 and 10 lb. per acre twice early in the season, twice late or at 14-day intervals throughout the season reduced injury with little difference between low and high dosages. The late applications tended to be better than the early ones, but the best results were obtained when applications were made throughout the growing period.

In 1940, promising results were obtained in preliminary tests with a poisoned bait of 20 parts ground sweet potato, 1 part paris green and 0·4 per cent. (by weight) of sodium benzoate [*cf. R.A.E.*, A **32** 235], and in 1941 the same bait was broadcast at weekly intervals at the rate of 120 lb. per acre until 14th July and 180 lb. per acre thereafter. The treatment reduced infestation in the plants but not in the tubers, and the foliage was severely scorched, particularly after the plants attained rank growth, by particles of bait that lodged on the large leaves.

In 1942, calcium arsenate was applied at weekly intervals for one or two months and fortnightly for two months, with no significant difference between treatments, though all were better than none ; 9·41 per cent. of the tubers were infested on untreated plots and 0·1 per cent on those receiving treatment fortnightly. In 1943, calcium arsenate and a mixture of calcium arsenate and cryolite (1 : 1) were applied once a week for one month or once a fortnight for two months and cryolite once a fortnight for two months, with no difference between treatments and no significant control at the end of September, though in the middle of November infestation was higher in untreated plots than in those treated fortnightly with calcium arsenate or the mixture. In 1944, applications of calcium arsenate made fortnightly for two months, throughout the season or from 15th July to the end of the season gave similar results and were all better than potassium fluosilicate applied once a fortnight throughout the season or 10 per cent. DDT dust applied once a month throughout the season. There were more infested tubers by weight on plots treated with potassium fluosilicate and DDT than on untreated plots.

In 1946, the treatments consisted of calcium arsenate with 1 per cent. light lubricating oil applied once a fortnight and once a month at 20 and 40 lb. per acre, respectively, 5 per cent. DDT with 1 per cent. oil applied once a fortnight throughout the season at 10 lb. per acre or from 1st August to the end of the season at 20 lb., undiluted *Ryania* and BHC (benzene hexachloride) in a dust containing 2·9 per cent. γ isomer applied once a fortnight throughout the season at 20 and 10 lb. per acre, respectively, and a culture treatment consisting of high hilling when the crop was laid by. The only effective treatments were the two with calcium arsenate and the cultural one. The best treatment (calcium arsenate fortnightly) resulted in a reduction of 19 bushels of infested tubers per acre, but since there was no consistent increase in yield of uninfested tubers, it was of doubtful value. In 1947, most of the insecticides were applied nine times at fortnightly intervals throughout the growing season. The greatest reduction of infested tubers was 87 per cent. (24 bushels per acre), obtained with calcium arsenate at 10 per lb acre. Although these results again showed that field infestations of the weevil can be reduced, they probably did not justify the number of applications necessary. BHC dust containing 5 per cent. γ isomer and applied at 20 lb. per acre was almost as effective as calcium arsenate, and calcium arsenate was almost as effective when applied once a month at 20 lb. per acre as when applied once a fortnight at 10 lb. Promising results were obtained with 10 per cent. chlorinated camphene [toxaphene] at 20 lb. per acre and with high hilling of the plants at the last cultivation. Treatment with 5 per cent. DDT at 20 lb. per acre or with an emulsified solution of DDT in xylene applied as a concentrated spray once a month at 1 lb. DDT per acre for the first two applications and 2 lb. for the last three was not effective.

Rings (R. W.) & Weaver (C. R.). **Effects of Benzene Hexachloride and DDT upon Parasitization of the Oriental Fruit Moth.**—*J. econ. Ent.* **41** no. 4 pp. 566–569, 1 fig., 4 refs. Menasha, Wis., 1948.

In Ohio many growers are reluctant to use DDT to control the oriental fruit moth [*Cydia molesta*, Busck] on peach for fear of eliminating its parasites, particularly *Macrocentrus ancylivorus*, Rohw., and observations were therefore made on the effects of BHC (benzene hexachloride) and DDT on parasite activity in several orchards representing various geographic sections of the State. The parasites and their hosts were reared from twigs [*cf. R.A.E.*, A **36** 23], and *M. ancylivorus* and *M. delicatus*, Cress., dominated the parasite populations (84·9 and 11·5 per cent., respectively). BHC was used in nine orchards, usually in May or early June, against the plum curculio [*Conotrachelus*

nenuphar, Hbst.], and samples of twigs from these and nine similar untreated orchards showed that parasitism of *Cydia* was higher in treated than in untreated orchards in five cases and lower in four, the differences not being significant. DDT was applied in 11 orchards against *C. molesta* between late July and late August 1947. Sprays were usually applied once or twice, though in one case four applications were made, and a 5 per cent. dust 3–4 times. Parasitism was significantly higher in untreated than in treated orchards, and comparison of the average amounts of parasitism before and after the applications of DDT showed that there was a marked increase in the untreated orchards, whereas the percentage in the treated ones remained nearly constant. The fact that the percentage parasitism was not materially reduced by the treatment may account for the ability of parasites to repopulate orchards the year after insecticide treatment. Maximum parasitism of the second-brood, twig-infesting larvae of *C. molesta* occurred on 24th July, after initial applications of DDT had been made, and during this period, when high rates of parasitism greatly reduce the eventual numbers of fruit-infesting larvae, parasitism in treated orchards was about 36 per cent. lower than in untreated ones. This difference would have little importance if DDT always gave commercial control of *C. molesta*, but it seems evident that at certain concentrations the residues may be very toxic to parasites and have little effect on the host. The residues of 5 per cent. DDT dust applications appear to approach this selective level more nearly than spray residues of the 50 per cent. wettable powders.

In one orchard in which a colony of 1,379 *M. ancylivorus* was released on 28th June, sprays of 2 lb. 50 per cent. wettable DDT powder were applied on 11th and 25th July and 11th and 26th August, and a total of 28 *Cydia* larvae collected on three sampling dates after the initial application gave rise to only one individual of *M. ancylivorus* and one of *M. delicatus*. Tests in orchards that had been treated with DDT in 1946 showed that the parasites had not been eliminated, though the population the following year may have been reduced.

Snapp (O. I.). **New Insecticides for Control of Plum Curculio on Peach.**—*J. econ. Ent.* **41** no. 4 pp. 569–574, 1 ref. Menasha, Wis., 1948.

In insectary and field tests in Georgia in 1947, adults of *Conotrachelus nenuphar*, Hbst., were caged on branches or twigs, bearing fruit and foliage, of peach trees that had been sprayed with various insecticides. The most effective was parathion, which, at rates of 0·5–2 lb. 15 per cent. wettable powder per 100 U.S. gals. water, gave complete kills within 2–5 days. Chlordan, chlorinated camphene [toxaphene], which was also applied as a dust, and hexaethyl tetraphosphate gave promising results, but BHC (benzene hexachloride) was not markedly more effective than lead arsenate, which gave complete mortality in a fortnight in some tests but not in others, and *Ryania* was relatively ineffective. Spray deposits of 2 lb. parathion powder per 100 U.S. gals. remained toxic to the weevils for 2–3 weeks after application, but the other insecticides had a less persistent effect, and hexaethyl tetraphosphate and toxaphene lost their effectiveness in a few days. In experiments carried out under commercial conditions, a schedule of four sprays of 2 lb. wettable BHC powder (4·5 per cent. γ isomer) per 100 U.S. gals. was not significantly more effective in reducing fruit infestation than 2 lb. lead arsenate, which failed to give satisfactory control. An application of BHC to infested dropped fruits, as a supplement to the regular sprays of lead arsenate, appeared to reduce infestation slightly, but the difference was not significant. The proportion of infested dropped fruits was low when the BHC powder was used at 4 lb. per 100 U.S. gals. in three applications followed by one of lead arsenate. Apparently it prevented fruit-drop early in the season. Ethyl-dibromide emulsion applied to the soil beneath the trees against larvae and pupae gave poor results.

No injury to the trees or alteration of fruit flavour was caused by any of the BHC schedules tested against the weevil or by one of 4 lb. 4·5 per cent. γ BHC per 100 U.S. gals. on 23rd April, followed by 6 lb. 3·79 per cent. γ BHC on 14th May, 9th June and 1st July, the last about four weeks before harvest. Chlordan, toxaphene, *Ryania* and parathion were also harmless, but hexaethyl tetraphosphate at a concentration as low as 0·67 pint per 100 gals. injured the foliage. BHC prevented the normal development of many of the larvae when applied to dropped fruits and, at high dosages, had some adverse effect on larvae that emerged from treated fruits before there was sufficient penetration of the material to kill them. It was comparatively ineffective against larvae or pupae when worked into the soil as a dust or applied to the soil surface as a spray.

Sherman (M.). **Relative Toxicity of the Isomers of Benzene Hexachloride to several Insects.**—*J. econ. Ent.* **41** no. 4 pp. 575–583, 7 refs. Menasha, Wis., 1948.

The following is based on the author's summary. Investigations were made in the laboratory on the relative toxicities to various insects of the five known isomers of benzene hexachloride as contact insecticides, stomach poisons and fumigants, and benzene heptachloride was included in some of the tests. Males and females of *Oncopeltus fasciatus*, Dall., and adults and fourth-instar larvae of *Epilachna varivestis*, Muls., were used to determine the toxicity of the isomers as contact insecticides, and the median lethal doses of the γ isomer to them, in mmg. per gm. body weight, were 2·48, 2·89, 57·4 and 47·3, respectively. The difference in the toxicity of the γ isomer to the two sexes of *O. fasciatus* was not significant, and the α, β, δ and ε isomers showed negligible toxicity to either at approximately 4,000, 2,000, 8,000 and 2,500 times the median lethal dose of the γ isomer, respectively. The difference in resistance between the larvae and adults of *E. varivestis* to the γ isomer was also not significant. The median lethal doses of the δ isomer and benzene heptachloride were about 54 times as great for the adults and 40 times as great for the larvae as that of the γ isomer, and the α, β and ε isomers showed no significant toxicity at 100, 50 and 100 times the latter, respectively.

The effects of the isomers as stomach poisons were determined for fifth-instar larvae of *Laphygma* (*Prodenia*) *eridania*, Cram. The median lethal dose of the γ isomer was 21·9 mmg. per gm., and that of the δ isomer about 50 times as great, while the α, β and ε isomers showed no toxicity at dosages about 100, 50 and 100 times as great, respectively. A preliminary test of the effect of the γ isomer as a contact insecticide for this species indicated that there was no significant difference in the effect of the isomer that could be attributed to the method of application.

The fumigation effects of the isomers and benzene heptachloride were studied at temperatures of 59, 68 and 86°F. The γ isomer was toxic to all the species tested, adults of *O. fasciatus* being the most susceptible and adults of *Tribolium castaneum*, Hbst., larvae of *Hyphantria textor*, Harr., and adults of *E. varivestis* progressively less so. Its effectiveness increased with temperature. The β, δ and ε isomers showed little or no toxicity, and the α isomer was appreciably toxic only to *O. fasciatus*. Benzene heptachloride was not toxic to *Oncopeltus* or *Epilachna*, the only species against which it was tested.

The different symptoms exhibited by *L. eridania* when affected by the γ and δ isomers suggested the possibility of different mechanisms of toxic action.

Stevenson (W. A.) & Kauffman (W.). **Benzene Hexachloride and other Insecticides to control Cotton Insects in Arizona.**—*J. econ. Ent.* **41** no. 4 pp. 583–585. Menasha, Wis., 1948.

In Arizona, the control of the Mirids, *Lygus* spp., *Creontiades femoralis*, Van D., *Adelphocoris superbus*, Uhl., and *Psallus seriatus*, Reut., and the

Pentatomids, *Euschistus impictiventris*, Stål, *Chlorochroa sayi*, Stål, and *Thyanta custator*, F., is the most serious problem in cotton growing, and BHC (benzene hexachloride), DDT and other insecticides were tested against them in 1946 [*cf. R.A.E.*, A **35** 180].

In an experiment with dusts applied to two fields at 20 lb. per acre by aeroplane five times in August–September, 5 and 10 per cent. DDT in sulphur and BHC dusts containing 1 and 2·5 per cent. γ isomer increased the yields by 410–422, 247–685, 355–487 and 392–450 lb. per acre. In another test in which 5 per cent. DDT in sulphur and BHC dusts (1 and 2 per cent. γ isomer, respectively) were applied at 20 lb. per acre on 3rd and 16th August, the insect populations were low in both plots except just before 12th August, when an influx of Pentatomids brought the mixed populations to a peak of 58 per 100 sweeps with a net in the DDT plot and 26 in the BHC plot ; the populations dropped to 6 per 100 sweeps in the DDT plot and two in the BHC plot after 16th August and remained low for the rest of the season. The yields were 2,776 lb. per acre for DDT and 2,311 for BHC. In a field in which the populations of injurious Hemiptera were extremely low throughout the season, with *Lygus* and *P. seriatus* predominating, three applications in August of 20 lb. per acre of 5 per cent. DDT in sulphur and BHC in 50 per cent. sulphur (2 per cent. γ isomer) resulted in average yields of 2,001 and 2,253 lb. seed cotton per acre, respectively, as compared with 1,943 for no treatment. Various fields in southern Arizona were treated with 15–20 lb. per acre of a dust containing 20 per cent. sabadilla against Pentatomids ; control was good in most fields, but not in all.

Aeroplane applications of a concentrated BHC spray at 3·5 U.S. gals. (4 oz. γ isomer) per acre on 14th August reduced the number of Pentatomids per 100 sweeps 22 hours later from twelve to three and the number of *Lygus* from four to none. In one hand-dusting test in which DDT, paris-green and BHC dusts were applied at about 20 lb. per acre four times in July–August, the increase in yield was greatest for 10 per cent. DDT in sulphur and least for paris green, and in another, dusts containing 5 and 10 per cent. DDT, 2 per cent. γ BHC and 25 per cent. *Ryania*, applied at the same rate in late July and August, resulted in increases of 398, 194, 37 and 273 lb. per acre ; the 10 per cent. dust in the second test had poor dusting qualities.

Laphygma exigua, Hb., causes some damage to seedling cotton in Arizona every year, but usually disappears when the cotton begins to form squares. The first generation is usually highly parasitised, but this was not so in 1946, when the second and third generations caused damage to the squares and blossoms similar to that due to *Heliothis armigera*, Hb. Complete control was obtained, however, with one application of 5 per cent. DDT in sulphur at 15–20 lb. per acre. Control of *H. armigera* was also obtained with the same dust applied at 20–25 lb. per acre, and it is concluded that this is the most satisfactory insecticide for general use against cotton insects in Arizona.

KRETZSCHMAR (G. P.). **Soybean Insects in Minnesota with special Reference to sampling Techniques.**—*J. econ. Ent.* **41** no. 4 pp. 586–591, 6 refs. Menasha, Wis., 1948.

During the summer of 1946, a study was made of the insects normally occurring on soy beans in Minnesota. Sampling cylinders of sheet celluloid fastened to wire frames were used, celluloid base plates being placed beneath the plants the day before the cylinders were installed, to eliminate the need for separating the insects from the soil under the plants, and sweep samples were taken in units of 15 sweeps per sample in various fields throughout the State and in units of three sweeps per sample in conjunction with cylinder samples for a comparison of the two methods. Leaf unit samples were used in

determining the number of nymphs of *Empoasca fabae*, Harr., in order to give a comparison between cylinder and sweep sampling methods.

Only 39 of the 84 identified species were found to occur in more than ten out of 298 collections, and 60 per cent. of all the individuals collected were adults and nymphs of *Empoasca fabae*. In spite of the abundance of the latter, damage by it was not evident. A few of the leaf-feeding insects may be potential pests because of their regular occurrence. *Diabrotica undecimpunctata howardi*, Barber (*duodecimpunctata*, auct.) was one of the first to appear in spring and fed throughout the growing season. Grasshoppers were only occasional feeders, but could cause great damage under certain conditions. *Plathypena scabra*, F., was effectively controlled by *Voria ruralis*, Fall., and *Apanteles flaviconchae*, Ril., but had caused considerable damage in some fields in 1944. There was no significant difference between the insect populations found on the two main varieties of soy beans grown in the State. Weedy fields had a larger and more varied insect population than fields under clean cultivation. The difference was most marked in the case of the flea-beetles, *Systena taeniata*, Say, and *S. frontalis*, F., and the Mirids, *Lygus oblineatus*, Say (*pratensis*, auct.), *Orthotylus flavosparsus*, Sahlb., and *Strongylocoris breviatus*, Knight. The one exception was *E. fabae*, which was more than five times as abundant in the clean-cultivated fields as in the weedy ones.

Comparison of sweep and cylinder samples taken from the same site showed that the sweep samples were unreliable for the estimation of numbers of any particular species present, the species that were the most abundant being the most underestimated. The reliability of the sweep samples varied with the size of the plant and the vertical spread of the leaf surface. A comparison of the methods used for sampling nymphs of *Empoasca* showed that unit leaf sampling does not always give an accurate picture of the population, discrepancies being largely attributable to changes of position on the plants.

MARSHALL (J.). **Oil Spray Investigations in British Columbia.**—*J. econ. Ent.* **41** no. 4 pp. 592–595, 2 refs. Menasha, Wis., 1948.

The following is substantially the author's summary. An investigation of orchard spray oils was begun in British Columbia in 1939 and is still in progress. It has led to the recommendation and general use of a dormant oil of high viscosity formerly considered unsuitable and has also resulted in the general use of summer oil of low unsulphonated residue.

Dormant oil with a viscosity of 200–220 S.S.U. at 100°F. was more effective against *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., and the winter eggs of *Paratetranychus pilosus*, C. & F., than oil of 100–110 S.S.U. and caused less injury to apple and pear, but was less effective against the apple mealybug, *Phenacoccus aceris*, Sign. Dormant oil of high viscosity index (presumably from mid-continent crude) was more effective against *Q. perniciosus* than California oil of similar viscosity at 100°F., but low viscosity index [*cf.* *R.A.E.*, A **30** 573], but was also more injurious to fruit trees. Differences in the performance of these oils are not attributed to variations in the amount of oil deposited. When applied undiluted to the trunks of apple trees over a period of six years, fuel oils and light summer oils proved considerably more injurious than light dormant oil, and light dormant oil of 100–110 S.S.U. viscosity at 100°F. was more injurious than heavy dormant oil of 200–220 S.S.U. Oil of high viscosity index caused more damage than oil of low viscosity index, and the unsulphonated residue of an oil seemed to have no bearing on its tendency to cause cambium injury.

When used at a concentration of 0·5 per cent. in five applications, summer oil of low unsulphonated residue (75 per cent.) was not visibly more injurious to apple fruits or foliage than oil of high unsulphonated residue (94 per cent.).

Residual fuel oil (bunker oil), of 1,200 S.S.U. viscosity at 100°F., applied as a summer spray at a concentration of 0·5 per cent., caused no more visible injury to apple than summer oil of 77 S.S.U. viscosity and 94 per cent. unsulphonated residue, and unlike the latter it did not cause defoliation when applied shortly after a sulphur spray.

Anderson (R. F.). **Host Selection by the Pine Engraver.**—*J. econ. Ent.* **41** no. 4 pp. 596–602, 10 refs. Menasha, Wis., 1948.

The results are given of experiments carried out in north-central Minnesota during the summers of 1940 and 1941 to determine how *Ips pini*, Say, selects trees and logs of *Pinus banksiana* for attack. It was found that the beetles were not strongly attracted to logs until these had been entered by a few male beetles. The strength of attraction increased with the number of fresh attacks, and logs entered by males were attractive for 2–9 days; those entered by females only were not attractive. Neither the extruded boring dust nor the products of fermentation in the inner bark attracted the beetles from a distance, and the odour that could be detected near freshly made entrance holes suggests that attraction may be due to a scent emitted by the males.

Investigation of the factors causing the initial attraction to uninfested trees showed that deviations, and especially an increase, in inner-bark moisture content from that in vigorously growing trees, appeared to be associated with increased attractiveness, and after beetles had been attracted by means of nearby infested logs to the immediate vicinity of untreated logs and logs wet with acetic acid and then dried, the latter were attacked the more readily, which supports the theory that volatile decomposition products may be associated with initial attraction when the beetles are in the immediate vicinity of uninfested logs [*cf. R.A.E.*, A **21** 97]. Brood survival was greatest when the inner-bark moisture condition did not deviate too greatly from that found in vigorous trees.

Chapman (R. K.) & Allen (T. C.). **Stimulation and Suppression of some Vegetable Plants by DDT.**—*J. econ. Ent.* **41** no. 4 pp. 616–623, 6 figs., 4 refs. Menasha, Wis., 1948.

The following is based on the authors' introduction and summary. Marked changes have been observed in the growth and appearance of various crops treated with DDT for insect control. Certain cucurbits have frequently shown chlorosis, stunting and decreased yields, whereas potato plants have often shown brighter green, broader and more open leaves, greater vine growth and increased yields. Such beneficial changes have generally been attributed to the elimination of injurious insects, but observations by the authors on potato in Wisconsin have indicated that DDT acts as a growth-promoting substance, since the plants responded more favourably when the concentration and number of applications of DDT were increased within certain limits, apparent stimulation was observed when insect populations were low and there was little difference in insect numbers in treated and untreated plots, and plant vigour failed to develop in plots treated with materials similar to DDT in effectiveness against insects. DDT was therefore applied at a wide range of concentrations in wettable powder sprays and dusts to a representative series of insect-free plants grown in the greenhouse early in 1946.

At high concentrations, DDT injured most plants and caused stunting, deformity, chlorosis and necrosis. The plants treated could be placed in the following order of decreasing susceptibility: squash, cucumber, tomato, bean, carrot, potato, pea and maize, the last four being extremely resistant to DDT injury. As the concentration of DDT was reduced, injury disappeared and

plant stimulation occurred at a definite level for each species. The amount of DDT required for maximum growth was very low for squash and cucumber (0·0005 per cent. DDT spray), intermediate for tomato (0·008) and bean (0·032) and high for carrot and potato (0·512 or higher). Peas and maize showed little injury or stimulation after one application of DDT. Similar results were obtained with dusts, but the effects were usually less pronounced.

All parts of the plant showed the greatest development at those concentrations of DDT that produced the greatest plant height, and stimulation of the upper part of the plant followed DDT applications to the lower leaves and roots. Concentrations of DDT that caused injury when applied to entire cucumber plants produced stimulation when applied to the lower leaves only. Bean, maize and cucumber seeds planted in sawdust treated with DDT were delayed in germination but made more rapid subsequent growth than those in untreated sawdust. The effects of DDT on plants closely resembled that of some plant hormones.

Smith (F. F.), Fulton (R. A.) & Lung (P. H.). **Recent Developments in the Control of Greenhouse Pests by liquefied-gas Aerosols.**—*J. econ. Ent.* **41** no. 4 pp. 624–631, 2 graphs, 12 refs. Menasha, Wis., 1948.

The following is based on the authors' summary and conclusions. Observations and experiments with liquefied-gas aerosols were made during the last six years in experimental greenhouses at Beltsville, Maryland, and in commercial greenhouses in several States.

DDT aerosols, the residue from which was found to be toxic, proved effective against thrips, certain Aphids, young mealybugs, *Periplaneta americana*, L., *Gryllodes sigillatus*, Wlk., woodlice, centipedes, *Phlyctaenia rubigalis*, Gn., the azalea leaf miner, *Gracillaria azaleella*, Brants, the rose midge, *Dasyneura rhodophaga*, Coq., and the chrysanthemum midge *Diarthronomyia chrysanthemi*, Ahlberg (*hypogaea*, auct.). Aerosols of HETP (hexaethyl tetraphosphate) were effective against *Tetranychus bimaculatus*, Harvey, *Trialeurodes vaporariorum*, Westw., two species of mealybugs, nine species of Aphids and two of thrips, but not against *Hemitarsonemus latus*, Banks, or two species of snails. Bodies of affected mites or insects shrivelled rapidly after treatment with HETP, but not after treatment with TEPP (tetraethyl pyrophosphate) or other materials. The killing action was most rapid with HETP. Parathion aerosols were toxic to the species killed by DDT and HETP and also killed *Pycnoscelus surinamensis*, L., leaf rollers, *Tarsonemus pallidus*, Banks, and spiders. They left a persistent garlic-like odour in the greenhouse and the residues had a fumigant effect on mites, Aphids and other insects. The danger to health of workers in greenhouses was not determined.

For the DDT aerosols, which contained 5 per cent. DDT with dichlordifluoromethane as the propellent gas, 100 gm. aerosol solution per 1,000 cu. ft. appeared to be adequate. *Kalanchoe* was injured by DDT in aerosols as well as in dusts and sprays, but no injury to the foliage or flowers of other greenhouse plants occurred except on cucumber when aerosols containing cyclohexanone were used. Formulae without this ingredient were devised for cucumber.

An aerosol solution of 10 per cent. HETP in methyl chloride was applied at the rate of 10 gm. solution per 1,000 cu. ft., but experiments indicated that 5 per cent. of this compound was more efficient than 10 per cent. in an aerosol. TEPP appeared to be about four times as toxic to mites and Aphids as HETP containing 21 per cent. of it. HETP injured tomato and chrysanthemum, certain varieties being apparently more susceptible than others. Other species of plants, including most of the commercial crops, were unaffected by repeated applications. Roses and other plants freed of mites by regular treatment were

more vigorous and productive. A sample of distilled TEPP in aerosols injured the same plants as HETP and also others that tolerated the latter. The lack of a toxic residue from HETP is a disadvantage from the standpoint of pest control, but is an advantage for the safety of workers returning to the greenhouse at the end of each treatment. It has been advantageous in virus studies, since toxic residues interfered with insect-vector tests and the freedom from mites permitted full and unmasked expression of virus symptoms.

The parathion aerosol contained 10 per cent. active ingredient and 10 per cent. acetone in methyl chloride and was applied at the rate of 10 gm. solution per 1,000 cu. ft. No plant injury followed its application to a wide variety of greenhouse crops, except on plants treated with sulphur.

The use of aerosols enables greenhouse crops to be treated rapidly, efficiently and with less labour than by spraying or dusting. In general, it also reduces disease spread, but it tends to permit powdery mildew on roses to become more serious where syringing is no longer practised.

HOERNER (J. L.). **The Cutworm** *Loxagrotis albicosta* **on Beans.**—*J. econ. Ent.* **41** no. 4 pp. 631–635, 1 fig., 6 refs. Menasha, Wis., 1948.

A cutworm that has injured pinto beans [a variety of *Phaseolus vulgaris*] in five counties of Colorado since 1941 has been identified as *Loxagrotis albicosta*, Sm. Injury of the same type has been reported in the State at intervals since 1915, and the moth has also been recorded from Idaho, Kansas and Nebraska. Field-cage tests showed that the larvae became full-fed in autumn, entered the soil and hibernated in earthen cells at depths of 4–9 inches. The first pupae were found on 26th June, and moths emerged between 24th July and 17th August. Eggs were deposited in groups of 3–79, usually on the under sides of the bean leaves, and hatched in seven days. The larvae remained continuously on the tops of the plants and fed on the leaves and buds until they were about half an inch long, after which they gnawed the pods and burrowed in the ground when not feeding. Those that were not full-fed when the plants were pulled and shocked collected in the soil under the drying heaps and fed at night or on cloudy days. If the shocks were removed, they fed on shattered beans and on fruits of ground cherry [*Physalis*]. They attacked several varieties of green beans and large lima beans when these were growing close to infested pinto beans ; no native food-plant has been found. Very few adults emerged when the larvae were caged over clay soil, but they emerged readily from sandy soil, though heavy rains or irrigation at emergence time appeared to be necessary. Most of the injured bean fields were on sandy soil and most injury occurred in the low parts of irrigated fields where the vines were very heavy. The larvae are sometimes carried into the sacks with the threshed and cleaned beans, but they do not then complete their development, so that infestation is not spread to other areas by this means.

In 1942, baits of cryolite or sodium arsenite mixed with bean meal, maize meal, bran or bran and sawdust and used dry or slightly moist gave only partial control when broadcast in bean fields at the rate of 25 lb. dry weight per acre in early September. The best control was 60 per cent. with a bait of 50 lb. bran, 1 U.S. quart sodium arsenite and 1 U.S. gal. white mineral oil. When baits were applied under shocked beans at the rate of 30 lb. per acre, the best control was 70 per cent. with one of 85 lb. bean meal, 3 U.S. pints sodium arsenite and 2 U.S. gals. water. Two fields in which baits were applied early in September, giving 50 per cent. kill, and again under the shocks, with 50 per cent. reduction of the remaining cutworms, still showed 12–17 per cent. injury. In 1943, baits containing sodium fluosilicate were broadcast or applied under shocks with approximately the same results (12–15 per cent. injured beans after two applications).

In dusting tests in 1943 and 1944, 25 per cent. basic copper arsenate applied at 50 lb. per acre in late August gave 80 per cent. control of larvae, and 3 per cent. DDT applied at 30 lb. per acre gave 99·8 per cent. control over a small area. When applied to the crop on 30th August 1945, 3 per cent. DDT, 25 per cent. basic copper arsenate and 33·3 per cent. cryolite, all in pyrophyllite, applied at 30, 50 and 50 lb. dust per acre, respectively, with an eight-row duster, reduced the numbers of larvae under the shocks by 97·01, 58·64 and 36·04 per cent., respectively, and gave commensurate reductions in injury to the beans before shocking. Dusts of 3 and 5 per cent. DDT in pyrophyllite were applied to cover the ground under bean shocks by means of a perforated pointed nozzle that could be inserted into the shock. There were 2–3 living larvae per shock six days after treatment with 3 per cent. DDT and an average of 86 under untreated shocks, and control was slightly better for 5 per cent. DDT. Treatment of two fields with 3 per cent. DDT in sulphur applied by aeroplane reduced the numbers of larvae under the shocks from 12 and 4 to 0·8 and 0·4 per shock, respectively.

Spray treatments were begun in 1944, when a field that had been sprayed twice with zinc arsenite against the Mexican bean beetle [*Epilachna varivestis*, Muls.] was treated once or twice with 2 lb. zinc arsenite, 3 lb. basic copper arsenate or 6 lb. cryolite per 100 U.S. gals. water or once with 1 lb. DDT per 100 U.S. gals., at the rate of about 100 U.S. gals. spray per acre. The best control (98·1 per cent.) was given by DDT ; zince arsenite gave about 90 per cent., copper arsenate less than 80, and cryolite was ineffective. In 1945, one application in late August of 0·75 and 1·2 lb. DDT per 100 U.S. gals. gave 98·4 and 98·7 per cent. control, and one of 3 lb. copper arsenate or 6 lb. cryolite gave 44·1 or 31 per cent. The addition of a small amount of DDT to the copper arsenate practically doubled the control. Of 100 larvae put under bean shocks on 1st October, 86 were recovered seven days later from unsprayed beans, 24 from those sprayed with 0·75 lb. DDT per 100 U.S. gals. on 31st August, and 6 from those sprayed with 1·2 lb. DDT on the same date.

FARRAR (M. D.), O'KANE (W. C.) & SMITH (H. W.). **Vacuum Dusting of Insects and Plants.**—*J. econ. Ent.* **41** no. 4 pp. 647–648, 1 fig. Menasha, Wis., 1948.

The authors describe a laboratory method of applying dusts to plants or insects quickly and in an extremely uniform manner. Plants or caged insects are put under a bell jar mounted on a base that enables air to be exhausted from it and containing a pan of the dust to be tested just under the top opening. A vacuum of about ten inches of mercury is produced under the bell jar, after which the stopper is removed and the air rushing in picks up the dust from the pan and deposits it almost instantly on all parts of the plant or insects. The apparatus was calibrated with DDT in pyrophyllite, and it was found that a load of 0·2 gm. dust per test gave the most consistent results. A standard concentration of 5 per cent. by weight was adopted for the first test with DDT or unknown chemicals, and the concentration was halved in successive tests until 50 per cent. control was obtained. The method was found satisfactory for biological evaluation of the organic insecticides now in use.

HUFFAKER (C. B.). **An improved Cage for Work with small Insects.**—*J. econ. Ent.* **41** no. 4 pp. 648–649, 1 ref. Menasha, Wis., 1948.

A modification of the rearing cell designed by F. Munger [*R.A.E.*, A **31** 104] for use on detached leaves is described, in which a sheet of transparent plastic 3mm. thick and containing a smoothly drilled circular opening 31 mm. in diameter is cut to the size of a water-proof plywood base and covered with a second plastic

sheet. The cell is a convenient size for use on bean, pear or apple leaves; bean leaves survived well under it when put on a gauze pad over two thicknesses of blotting paper.

THORNE (F. T.). **Additional Host Records for the Scale *Parlatoria theae* in California.**—*J. econ. Ent.* **41** no. 4 p. 649, 3 refs. Menasha, Wis., 1948.

In the course of surveys for new pests in California, a heavy infestation by *Parlatoria theae*, Ckll., was discovered in the city of San Diego. It was found on avocado, *Bauhinia*, apricot, loquat and *Pyracantha*, which are new food-plant records, and also on rose, plum and an ornamental *Pyrus*, but not on *Citrus*, *Hibiscus* and *Poinsettia*, which it infests elsewhere. Extensive measures, including fumigation with hydrocyanic acid gas and the application of oil sprays, were undertaken to eradicate this incipient infestation of a potentially injurious oriental species.

HUFFAKER (C. B.). **A Technique for Translocation of DDT in Plants.**—*J. econ. Ent.* **41** no. 4 pp. 650–651, 3 refs. Menasha, Wis., 1948.

Three methods were tested for introducing DDT into bean leaves without any surface treatment. In the first, pellets of DDT and a polyethylene glycol (1 : 1) were put on each primary leaf; in the second, pellets of DDT and lanolin (1 : 1) were similarly applied; and in the third a solution of DDT in polyethylene glycol was dispersed in water to give 5 per cent. DDT w/v, and cotton twine wicks with one end in a 5 cc. vial of the material were threaded through the stems of the plants at ground level. The vials were refilled once after a week.

Analysis of the top three compound leaves for DDT content when the plants were four weeks old showed the presence of 1·8, 4·5 and 11·3 parts DDT per million for the three methods, and when adults of *Scymnus binaevatus*, Muls., a Coccinellid sensitive to DDT, were exposed in petri dishes bearing a residue of alcohol-soaked and macerated upper leaves from the wick-fed plants, the mortality averaged 87 per cent. in 12 days, as compared with 13 per cent. for no treatment. Since the wick method gave by far the highest DDT content, it is obvious that the DDT travelled through the translocation stream and was not a result of contamination. Scorching of the leaf tips resulted from the treatment and was particularly noticeable on plants held under greater shade and treated by the wick method.

The method was used to discover whether the feeding of mites on leaves treated with DDT increased their fecundity, which would explain the outbreaks of mites frequently associated with the uses of DDT. No such increase was shown for *Tetranychus bimaculatus*, Harvey, the species tested.

GAMBRELL (F. L.). **Experiments with DDT for Control of the Potato Leafhopper on Apple Nursery Stock.**—*J. econ. Ent.* **41** no. 4 pp. 651–652, 2 figs., 2 refs. Menasha, Wis., 1948.

Empoasca fabae, Harr., is often a serious pest of apple in nurseries, where the nymphs and adults feed on the tender terminal growth, cause the leaves to curl and produce a stunting that affects the quality of the nursery stock. In 1946, injury was common on apple seedlings and trees one and two years old in western New York. Overwintered adults, young nymphs and evidence of feeding were observed on 5th June, many leaves on one-year apple terminals were badly curled by 30th June and injury was evident on the terminals of two-year-old trees by 15th July. Adults of the first generation were numerous on 1st August, and the population of second-generation nymphs and adults increased from 180 per ten sweeps of a net on 6th August to 327 on 16th August.

A dust of 3 per cent. DDT in talc was applied by aeroplane to one-year-old trees at 45 lb. per acre and to seedlings at 85 lb. per acre on 6th August and to another block of one-year-old trees at 65 lb. per acre on 22nd August. The dusts were applied between 7 and 9 a.m. under favourable conditions, with little or no wind and at temperatures of 65–75°F. The treatments gave more than 92 per cent. reduction in population 2–6 hours after treatment, at least 98 per cent. after 24 hours and 63·3, 85·5 and 98·2 per cent. after a fortnight. All the plots were dusted or sprayed with nicotine against the green apple aphis [*Aphis pomi*, Deg.] before the third population records were made, but these applications were light and may not have affected the records seriously. The two plots that showed a noticeable increase in infestation after a fortnight contained a high proportion of adults at the time of treatment, whereas the other contained about equal numbers of nymphs and adults, suggesting that many eggs of the summer generation had already hatched and that the second generation was practically completed. Coverage of the lower surface of the leaves was not very thorough.

Jefferson (R. N.) & Pence (R. J.). **Preliminary Experiments on the Control of the Leaf Miner *Liriomyza flaveola* on Asters.**—*J. econ. Ent.* **41** no. 4 pp. 653–655, 2 refs. Menasha, Wis., 1948.

In recent years, *Liriomyza flaveola*, Fall., has caused serious losses of field-grown asters in the Los Angeles area of California and has not been satisfactorily controlled by nicotine or DDT. In 1947, tests of some of the newer insecticides were begun. Dusts were applied at about 150 lb. per acre once a week and sprays at a pressure of 300 lb. at intervals of 2–3 weeks. All spray quantities are given per 100 U.S. gals. and refer to active ingredient.

In one test, two applications of an emulsified solution of chlordan and Velsicol AR-60 (2 : 1, with a blood-albumin spreader), used at 2·25 lb., gave excellent control under conditions of severe infestation, reducing the average number of mines per stem from 41·4 to 2·8. In other tests, the same spray was applied once or twice at the same concentration or two or three times at 1·68 or three times at 1·12 lb., sprays of 50 per cent. wettable chlordan powder were applied once or twice at 2·25 lb. or three times at 1 lb., sprays of 50 and 40 per cent. emulsifiable chlordan twice at 2·25 and 0·84 lb., respectively, and sprays of 20 per cent. emulsifiable parathion at 0·75 lb., 15 per cent. wettable parathion at 0·23 lb. and 50 per cent. emulsifiable toxaphene at 1·25 lb. once, twice and twice, respectively. A dust of 5 per cent. chlordan was applied twice at 7·5 lb. chlordan per acre and one of 0·75 per cent. γ BHC (benzene hexachloride) twice and three times at 1·13 lb. γ BHC per acre. All the treatments gave significant or highly significant control, with no significant difference between those used in individual tests, except the spray of 40 per cent. chlordan, which was probably applied too few times. Parathion and toxaphene showed enough promise to warrant further testing.

Carlson (F. W.), Yothers (M. A.) & Dean (F. P.). **DDT, Benzene Hexachloride and Sabadilla to control Climbing Cutworms on Peaches and Apricots.**—*J. econ. Ent.* **41** no. 4 p. 655. Menasha, Wis., 1948.

Climbing cutworms often cause considerable losses of peaches and apricots in Washington by destroying the fruit buds shortly before or during blossom time, and sprays and dusts of DDT, BHC (benzene hexachloride) and activated sabadilla were tested for their control near Yakima in the spring of 1947. On 21st March, sprays of 1 lb. insecticide per 100 U.S. gals. water were applied to the trunk and crotch of the trees and to the soil for several inches round their bases with a bucket pump at the rate of approximately 3 U.S. pints

per tree, and dusts of the same materials at about 2–3 oz. per tree with a hand duster, in part of an orchard in which cutworms had already eaten off most of the fruit buds on several trees. Each treatment was applied to nine or ten trees, and ten trees served as controls. Examination of the soil at the base of the trees 4–6 days after treatment showed 169, 97 and 121 cutworms, of which 89, 17 and 12 per cent. were dead, under trees sprayed with DDT, BHC (7·5 per cent. γ isomer) and sabadilla, 172, 92 and 186, of which 95, 95 and 43 per cent. were dead under those dusted with 6 per cent. DDT, 7·5 per cent. γ BHC and 10 per cent. sabadilla, and 127, all living, under the untreated trees. The smaller numbers of larvae found under the trees treated with BHC may indicate a repellent effect. Ten trees of which the trunks were banded with adhesive on 22nd March had only 59 cutworms, all living, under them about 3–5 days later, indicating that the barrier caused many to leave, evidently in search of food elsewhere.

The best time for application and the proper quantities of materials have not yet been decided, but as a result of the preliminary tests, DDT dust has come into general use for the control of climbing cutworms in peach and apricot orchards in the Yakima and Wenatchee districts of Washington.

Owen (F. E.) & Brown (A. W. A.). **A Hopper and Emission Apparatus for Distribution of Grasshopper Baits from an Airplane.**—*J. econ. Ent.* **41** no. 4 pp. 656–657, 2 figs., 2 refs. Menasha, Wis., 1948.

The following is the authors' summary. A hopper for distributing grasshopper bait from aircraft is described, which utilises the suction of the slipstream to facilitate emission, and does not require mechanical devices for agitation and delivery regulation. It will deliver oil-base baits at approximately even rates, determined by the aperture opening, in the range between 7 and 20 lb. per second. Water-base baits may be similarly handled only if freshly made. The hopper is mounted in the fuselage, and may be filled while in flight. One thousand pounds of bait may be thus applied at distances in excess of 100 miles from base.

Stewart (W. S.) & Gammon (C.). **A back-pack Fog Gun for 2,4-D Application.**—*J. econ. Ent.* **41** no. 4 p. 658. Menasha, Wis., 1948.

In the course of an attempt to control *Harrisina brillians*, B. & McD., attacking grape vines in California, 2,4-D was used to eradicate wild grape vines and so prevent the migration of the Zygaenid from the infested area [*cf. R.A.E.*, A **36** 397]. As most of the wild vines were in canyons that could be reached only on foot, it was necessary to use portable equipment. Aerosol applications of 2,4-D were known to be more effective for certain purposes than applications by other methods, and a portable fog gun, such as has been used to apply DDT against household pests for three years, was therefore used. It consists of a steel cylinder closed at the ends and with a free moving piston. On one side of the piston the cylinder is charged with nitrogen gas at a pressure of 350 lb. per square inch at the factory, and on the other it is permanently connected to a lightweight hydraulic hand pump, which is used to pump the solution to be dispensed into the cylinder to a pressure of 1,000 lb. per sq. in. against the nitrogen. Valves prevent its flow back through the pump. The portion of the cylinder containing the liquid is connected directly to a core-type atomising nozzle by means of a flexible high-pressure hose, and a hand valve in the hose line allows the solution in the cylinder to escape through the nozzle. Even at the lowest operating pressure (350 lb. per sq. in.) the nozzle produces a finely dispersed aerosol-like fog. The discharge time varies from 12 to 20 minutes, depending on the viscosity and other properties of the solution, and the gun weighs 28 lb. and can be charged with 0·45 U.S. gal. solution.

The use of these guns to apply 10–40 per cent. 2,4-D solutions to wild vines resulted in satisfactory destruction of all the ground cover foliage to a height of 10 ft. and of some up to 40 ft., apparently depending on wind currents, and in one canyon the characteristic 2,4-D odour was detected more than a mile from the point of application. Similar kills of other weeds susceptible to 2,4-D were obtained.

In experimental studies, fog applications of 2,4-D killed few if any leaves on wild blackberry, wild rose, oak, buckwheat or *Baccharis* sp., and mature leaves on sycamore [*Platanus*] and poison oak [? *Rhus diversiloba*] were only moderately affected. Alder, willow, California black walnut [*Juglans californica*], ragweed [*Ambrosia*] and *Artemisia* sp. were killed, and this method of application should be used with caution when drift would injure valuable plants.

Siegler (E. H.) & Gertler (S. I.). **Laboratory Tests of N-substituted *m*-Nitrobenzamides against the Codling Moth.**—*J. econ. Ent.* **41** no. 4 pp. 658–659. Menasha, Wis., 1948.

In tests on newly hatched larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., by the apple-plug method [*cf. R.A.E.*, A **23** 174], 17 N-substituted m-nitrobenzamides, used at a concentration of 4 lb. per 100 U.S. gals. 20 per cent. ethyl alcohol, were compared with lead arsenate at 4 lb. and DDT at 1 and 0·25 lb. None of the amides showed promise.

Pederson (C. E.) & Sherman III (F.). **Field Applications to control Spittle Bugs in Michigan.**—*J. econ. Ent.* **41** no. 4 pp. 659–661, 3 refs. Menasha, Wis., 1948.

Varieties of *Philaenus leucophthalmus*, L., have caused severe damage to strawberries and leguminous field crops in Michigan, and investigations on their control were therefore carried out in 1947. When sprays were applied to strawberry at approximately 450 U.S. gals. per acre on a clear day in May at a temperature of 67–70°F., the average percentage of plants infested by nymphs five days later was reduced from 55 for no treatment to 0 for 1·5 and 3 lb. BHC powder (50 per cent. total isomers of benzene hexachloride and 6 per cent. γ isomer), 16 for 3·25 lb. 4·8 per cent. rotenone with a spreader, 9 and 18 for 1 and 2 U.S. pints nicotine sulphate with 2 lb. hydrated lime and a spreader, 40 for 1 U.S. pint hexaethyl tetraphosphate with 1 U.S. quart summer oil, and 29 and 24 for 1·5 lb. 50 per cent. wettable DDT powder, with and without 3 lb. fixed nicotine, all per 100 U.S. gals. water. Subsequent observation showed that even lower dosages of BHC gave excellent control. A low percentage of infestation on untreated plants that were not hit directly by spray but were near plants treated with BHC suggested a marked fumigating effect. Little odour of BHC was detected five days after treatment, and there was no objectionable taste or odour from fresh or cooked strawberries that had been sprayed not less than a week before harvest. When the treatments with nicotine sulphate were repeated, the lower concentration was no better than the other, and it is possible that the weaker nicotine-sulphate solution in the original tests may have been contaminated by small amounts of BHC in the sprayer.

In tests on lucerne, sprays of 2 lb. per 100 U.S. gals. of the BHC powder at 60 and 120 U.S. gals. per acre applied on 11th June, when the nymphs had been present for about three weeks, reduced the percentage of stems infested from 88–92 to 0–2 and 0, respectively, and increased the yield of hay by 672 and 832 lb. per acre. There was no odour of BHC in either freshly cut or dried hay. In the course of tests against other insects infesting mammoth clover [*Trifolium medium*], dusts were applied in late June, when the first adults of

Philaenus were emerging. The percentages of stems infested a week later were 57 and 23 for two untreated plots, 28 for 2 per cent. chlordan with 3 per cent. DDT, 42 for 5 per cent. DDT, 4 for 0·25 per cent. γ BHC with 2·5 per cent. DDT, and 0 for 0·36 per cent. γ BHC ; all materials were diluted in pyrophyllite, and the rate of application was 30 lb. per acre.

Fluke (C. L.). **Control of Buffalo Treehopper Adults with DDT.**—*J. econ. Ent.* **41** no. 4 pp. 664–665, 2 refs. Menasha, Wis., 1948.

In Wisconsin, where *Ceresa bubalus*, F., cannot always be controlled by clean cultivation [*cf. R.A.E.*, A **33** 285], since many orchards are maintained in sod, a spray of 2 lb. 50 per cent. wettable DDT powder per 100 U.S. gals., applied to the newly mown ground cover under young apple trees at the rate of 100 U.S. gals. per acre against the nymphs on 21st July, reduced the numbers of adults collected in 100 sweeps of a net on 14th August from 78 to 45, but this was not sufficient for commercial control. Preliminary cage tests indicated that DDT was toxic to the adults, and the same block of trees and the ground cover under them were therefore sprayed on 23rd August, when oviposition was beginning, with 3 lb. of the DDT powder per 100 U.S. gals. On 26th August, no adults were found on the trees or ground cover in sprayed areas, whereas 34 were taken from the ground cover and 57 from the trees in 100 sweeps of the net in unsprayed areas. Since none was found in the sprayed area during the next two weeks, the remaining trees of the orchard were treated similarly, with practically complete control.

Fife (L. C.), Chapman (A. J.) & Shiller (I.). **Toxicity of several Chlorinated Hydrocarbons to Thrips on Cotton.**—*J. econ. Ent.* **41** no. 4 pp. 665. Menasha, Wis., 1948.

In tests against *Thrips tabaci*, Lind., on seedling cotton at Bayview, Texas, in the spring of 1947, various dusts were applied to plots at rates of about 9–12 lb. per acre early in the morning of 1st May, when the plants were wet with dew and the air was fairly calm. Counts made 24 hours later showed that all had reduced the thrips populations by 96–100 per cent., and counts after five days showed percentage reductions of 99, 98 and 93 for 20, 10 and 5 per cent. chlorinated camphene [toxaphene] in pyrophyllite, 76 for 5 per cent. DDT, 63 for 2·5 per cent. DDT with 0·25 per cent. γ benzene hexachloride and 71 for 5 per cent. chlordan.

Sakimura (K.). **Residual Toxicity of Hexachlorocyclohexane incorporated in Soil.**—*J. econ. Ent.* **41** no. 4 pp. 665–666, 5 refs. Menasha, Wis., 1948.

Anomala orientalis, Waterh., is the most injurious soil insect attacking pineapple in Hawaii. It has 3–4 generations a year and consequently increases to destructive numbers during the $2\frac{1}{2}$–$3\frac{1}{2}$ years of the crop cycle, although populations are usually negligible at the time of planting. Since a soil insecticide with persistent toxicity is required for control, BHC powder (30 per cent. γ isomer of benzene hexachloride) dissolved in xylene and mixed with pyrophyllite to give 3 per cent. γ BHC was compared with 10 per cent. DDT dust. Double-sifted clay loam soil collected from a pineapple field was mixed with them at various rates and put in cans, and young third-instar larvae of *A. orientalis* were introduced after various intervals, with pea seeds to provide food. DDT at 25, 50 and 100 lb. per acre (to a depth of 12 ins.) gave 91, 100 and 100 per cent. mortality immediately, 86·1, 95·6 and 97·9 per cent. after eight months and 40, 50 and 75·3 per cent. after 26 months. BHC gave 44·2, 36·8, 69·5 and 98 per cent. immediately after treatment with 0·75, 1·5, 3 and

4·5 lb. γ isomer per acre, complete mortality immediately after treatment with 7·5–60 lb. per acre, 71·5, 92 and 99 per cent. 19 months after treatment with 4·5, 7·5 and 12 lb. per acre, and complete mortality 19 months after treatment with 15–60 lb. per acre, proving that the rate of deterioration of BHC was no higher than that of DDT. BHC caused no appreciable decrease in germination of garden peas at rates of up to 60 lb. γ isomer per acre, but slight and severe injury to plant growth, particularly the roots, at 15 and 60 lb., respectively.

FRANKLIN (H. J.). **The Cranberry Station, East Wareham, Massachusetts.**—*Bull. Mass. agric. Exp. Sta.* no. 436 (Rep. 1945–46) pp. 29–30. Amherst, Mass., 1946.

Infestation of cranberries by the gipsy moth [*Lymantria dispar*, L.] was again heavy in some parts of Massachusetts in 1945 [*cf. R.A.E.*, A **36** 100], but in 1946 complete kill was obtained on the bogs and surrounding uplands with sprays of 2 or 3 lb. 50 per cent. wettable DDT powder per 100 U.S. gals. water, applied at the rate of 400 or 250 U.S. gals. per acre, respectively, or with dusts of 5 per cent. DDT at 50 lb. per acre ; the DDT caused no injury to the cranberry plants. The first generation of the black-headed fireworm [*Rhopobota naevana*, Hb.] was apparently satisfactorily controlled by the same sprays and dusts of DDT applied in May and early June. DDT should not be used against the second generation or against blunt-nosed leafhoppers, *Ophiola vaccinii*, Van D.], until more is known of its effects on bees. Flooding for as little as ten hours controlled first-generation larvae of *R. naevana* that were less than one-third grown if repeated once or twice at intervals of 7–10 days. It is especially important to kill the early first-generation larvae, since it is these that give rise to the partial second generation. A short flooding kills the smaller larvae more easily than the larger ones, and short floodings are less likely to harm the plants. Infestation by *Crambus* [*hortuellus*, Hb.] on cranberry bogs on Cape Cod was more severe in 1945 than for many years, evidently owing largely to the omission of sanding and of dusting with pyrethrum. Infestation by *Agrotis* (*Euxoa*) [*ypsilon*, Hfn.] occurred chiefly on bogs flooded for the control of *Amphicoma* [*vulpina*, Hentz].

ALEXANDER (C. P.) & others. **Department of Entomology.**—*Bull. Mass. agric. Exp. Sta.* no. 436 (Rep. 1945–46) pp. 33–43. Amherst, Mass., 1946.

In experiments in Massachusetts in 1945 in which sprays including DDT and wettable sulphur were applied five times between 15th May and 25th July to apple that received a calyx spray of lead arsenate, concentrations of 1–2 lb. DDT per 100 U.S. gals. did not control the plum curculio [*Conotrachelus nenuphar*, Hbst.] so well as a combination of 2 lb. lead arsenate and 0·5 lb. DDT [*cf. R.A.E.*, A **36** 100], even with the addition of a fish-oil adhesive in the first cover spray, but both these treatments gave good control of the codling moth [*Cydia pomonella*, L.]. Scab [*Venturia inaequalis*] was well controlled in all plots, indicating that the presence of DDT did not affect the efficiency of wettable sulphur, damage by minor insect pests was very slight and there was no trace of damage by the apple maggot [*Rhagoletis pomonella*, Walsh] in the fruit of any of the sprayed plots. An abbreviated schedule, including a special sulphur dust and a sulphur-spray combination for scab control, a special cover spray of sulphur and lead arsenate in early June and the first spray against *R. pomonella* on 12th July, which was used to give moderate protection of such fruit as survived the early cold weather and maintain the trees in good condition for the following season, resulted in 71 per cent. clean fruit, 2 per cent. damage by *Conotrachelus*, 5 per cent. by *Cydia*, 2 per cent. by scab and 2·4 per cent. by minor pests, as compared with

corresponding percentages of 87, 5·8, 2·5, 0·8 and 2·9 for the standard lead-arsenate schedule. There was only a trace of damage by *R. pomonella* in the orchard. In laboratory tests, suspensions containing 2 lb. actual DDT per 100 U.S. gals. gave reasonable control of *Conotrachelus* and were about as effective as 4 lb. lead arsenate. The time required to kill the weevils and the numbers of punctures made in sprayed apples decreased consistently as the concentration of DDT was increased, and a spray containing 4 lb. DDT per 100 U.S. gals. water gave almost perfect protection. Combinations of lead arsenate and DDT were generally more effective than equal amounts of either alone ; a combination of 4 lb. lead arsenate and 2 lb. DDT per 100 U.S. gals. was very effective and highly promising for practical use. In orchard tests, applications of the regular schedule, using 4 lb. wettable sulphur and 2 oz. sulphated-alcohol spreader with either 4 lb. lead arsenate and 1 lb. DDT, 2 lb. lead arsenate and 1 lb. DDT or 4 lb. lead arsenate alone per 100 U.S. gals. gave 89·63, 78·47 and 60·44 per cent. apples free from scars, as compared with 4·62 per cent. for no treatment. One-year-old apple trees that showed an average infestation of about three half-grown larvae of the gipsy moth [*Lymantria dispar*, L.] per tree and considerable foliage injury were sprayed once with 0·8 lb. DDT per 100 U.S. gals. with a wettable-sulphur fungicide or with 5 lb. lead arsenate per 100 U.S. gals. with wettable sulphur and excess lime, and examination five days after treatment showed no larvae on those treated with DDT, and only one on those receiving the arsenical spray.

In laboratory tests against the grape cane girdler [*Ampeloglypter ater*, Lec.] on grape vine, neither girdling nor oviposition occurred on canes sprayed with DDT, and adults caged on them lived about half as long as those on canes sprayed with lead arsenate or cryolite ; the number of feeding scars was reduced proportionately. In two series of laboratory tests against adults of the rose chafer [*Macrodactylus subspinosus*, F.], sprays of 0·4 and 0·8 lb. DDT per 100 U.S. gals. and a 5 per cent. DDT dust gave complete kill in two days, with practically no feeding or normal activity after treatment.

In experiments in which potatoes were sprayed 12 times between 11th June and 11th September, a spray containing 0·4 lb. DDT per 100 U.S. gals. home-made Bordeaux mixture (10 : 5 : 100) caused a conspicuous reduction in damage by flea-beetles [*Epitrix cucumeris*, Harr.], with no Aphid infestation, and a yield of 273 bushels per acre, as compared with 261 bushels after treatment with calcium arsenate in standard Bordeaux mixture (10 : 10 : 100), and about 195 bushels after treatment with either Bordeaux mixture alone. The plants sprayed with DDT had a more vigorous growth and stayed green for longer than any others. A heavy infestation by the tarnished plant bug [*Lygus oblineatus*, Say], which migrated from recently cut clover and attacked most of the growing tips in a field of potatoes, was eliminated in about three days by one application of 0·5 lb. DDT per 100 U.S. gals., and subsequent applications to potatoes and an adjoining strip of clover stubble prevented further migration ; the plants recovered and gave an excellent yield. On onions, sprays of 0·4 lb. DDT, 4 lb. derris powder (4 per cent. rotenone) and 3 lb. fixed nicotine, respectively, per 100 U.S. gals. gave 89, 90 and 91 per cent. control of onion thrips [*Thrips tabaci*, Lind.] and dusts containing 5 per cent. DDT and 1 per cent. rotenone gave 90 and 81 per cent. Four days after treatment, the control percentages were 85, 38 and 71 for the sprays and 98 and 24 for the dusts, indicating that DDT had a considerable persistent effect. In another test, the addition of a wetting agent (6 fl. oz. Triton X-100 per 100 U.S. gals.) to all sprays improved applications and effectiveness, increasing the percentage control for DDT and derris sprays to 99 and 98·8 ; DDT dust gave 93 per cent. control.

Cabbages showed varying resistance to a moderate infestation by the cabbage maggot [*Hylemyia brassicae*, Bch.], 94, 88, 47 and 12 per cent. of unsprayed

plants of four varieties being free from injury. One application to the third of these of a dust of 4 per cent. mercurous chloride (calomel) in talc in small mounds about the stems of the plants gave complete protection and 90 per cent. marketable heads, two applications of 1 oz. mercuric chloride (corrosive sublimate) per 10 U.S. gals. water gave 95 per cent. protection, and two applications with a hand duster of 5 per cent. DDT in talc a week apart gave 95 per cent. protection and were more effective than 3 per cent. DDT in talc applied with a duster or in a mound round the stem of each plant. A solution of 1 per cent. DDT was effective but injured the roots of the plants, apparently owing to the action of the solvent. Unfavourable weather in May and early June reduced the first generation of *Lygus campestris*, L., on celery to a minimum, but the second generation caused severe injury to all untreated plants of the second planting. In a field in which untreated celery was infested by 12–70 bugs per 10 plants, dusts of 3 and 5 per cent. DDT in talc prevented reinfestation for 33 days and dusts of 20 and 50 per cent. sabadilla in lime gave protection for 14–19 days; these treatments produced 70–80 per cent. marketable plants. Dusts containing pyrethrum and rotenone killed the bugs, but permitted reinfestation after 5–7 days. Infestation of maize by the European corn borer [*Pyrausta nubilalis*, Hb.] was light. Counts of tassel breakage as an index of stalk infestation, made just before harvest, showed none on sweet maize sprayed four times with 0·4 lb. DDT per 100 U.S. gals. with a spreader or dusted four times with 5 per cent. DDT, and only 9·5 per cent. on untreated plants, and yield records showed 0·75 per cent. infested ears in plots sprayed with DDT, none in dusted plots and 1·7 per cent. in untreated ones.

In further tests of sprays for the prevention or control of infestation of elm logs by Scolytids [*cf.* **35** 103], single applications of 123 and 213 cc., but not 166 cc., no. 2 fuel oil and of 113 or 115 cc. of a solution of orthodichlorbenzene in fuel oil (1 : 4 or 1 : 8, respectively) per square foot of bark surface in spring completely prevented infestation, and sprays of 18 gm. 20 per cent. DDT wettable powder per 3,785 cc. water, 20 per cent. DDT emulsion concentrate and water (1 : 200), kerosene, used crankcase oil, and orthodichlorbenzene and fuel oil (1 : 12 and 1 : 16) gave more than 90 per cent. protection at rates of 195, 179, 135, 169, 105 and 107 cc. per sq. ft.; *Scolytus multistriatus*, Marsh., was the only or the predominant Scolytid in the logs. Six applications of 176 cc. fuel oil per sq. ft. at intervals of three weeks from 31st May also gave complete protection, and six of 158 cc. DDT emulsion concentrate and water (1 : 200) gave 90 per cent. When applied to the surface of logs infested by *S. multistriatus* and *Hylastes* (*Hylurgopinus*) *rufipes*, Eich., on 20th July, sprays of creosote and kerosene (1 : 4) at 189 cc. per sq. ft. and orthodichlorbenzene in fuel oil (1 : 8) at 208 cc. gave more than 90 per cent. control, fuel oil and kerosene alone at 200 and 186 cc. gave nearly 70 and 60 per cent., respectively, and 20 per cent. DDT emulsion concentrate and water (1 : 400 and 1 : 200) and 18 gm. 20 per cent. DDT wettable powder in 3,785 cc. water at 133–181 cc. were ineffective. Four applications of the last two at intervals of three weeks from 20th July were also ineffective, but four of DDT emulsion concentrate and water (1 : 400) at 182 cc. per sq. ft. gave 52·9 per cent. control. Although no significant reduction in the number of exit holes resulted from some of the DDT sprays, dead adults were occasionally found in the exit holes; this was not observed in logs sprayed with any other materials.

The effectiveness of spreading logs singly in a north-south position in the sun was estimated by the percentage reduction in numbers of exit holes and living Scolytids per sq. ft. in late October as compared with those in logs piled in partial shade. The maximum thickness of bark of the logs is given in brackets. The percentage reductions were: 63·2 for logs (1·5 ins.) left undisturbed in the sun from 25th May onwards, in which there were practically no brood galleries in the upper halves; 79·6 in logs (1 in.) similarly exposed but turned over on

12th July, after the lower portion had become infested; 95 in logs (1 in.) that were piled in the shade on 25th May, spread singly in the sun on 12th July and turned over on 2nd August; 99·7 in logs (1·75 ins.) spread in the sun on 25th May, turned over every week until 17th August and then left undisturbed and 98·8 in logs (1·5 ins.) that were turned over every two weeks during the same period; and over 99·9 in logs (1 in.) left in the sun from 25th May and having the lower half sprayed with strained creosote and kerosene (1 : 4). In these tests, brood galleries of *S. multistriatus* and *H. rufipes* were almost equally abundant.

THAYER (C. L.) & others. **Department of Floriculture.**—*Bull. Mass. agric. Exp. Sta.* no. 436 (Rep. 1945–46) pp. 44–45. Amherst, Mass., 1946.

This report includes an account by H. E. White of tests carried out at Waltham, Massachusetts, on the control of the red spider [*Tetranychus*] on carnation by applying sodium selenate to the soil [*cf. R.A.E.*, A **36** 290]. Two methods of application were used. In one, pure sodium selenate was dissolved in water at the rate of 1 gm. per U.S. gal. and 1 U.S. quart ($\frac{1}{4}$ gm. selenate) was applied per square foot of soil, and in the other, superphosphate impregnated with 2 per cent. sodium selenate was applied to the soil at rates of 3, 4 and 6 lb. per 100 sq. ft. ($\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{2}$ gm. selenate per sq. ft.). These dosages gave effective control of the mite and caused no injury to the plants. The plants should be treated after they are established in the soil, and at least four weeks must be allowed for the effect of the treatment to show. Preliminary tests indicated that pre-treatment of the soil with $\frac{1}{4}$ gm. sodium selenate per sq. ft., six weeks before planting, may be safe. Young actively growing plants responded more readily to treatment than older ones, and variations in soil conditions and other factors may affect the results. Young plants in flats remained free of mites for 5–6 months after one treatment in early spring, and treatment in July kept plants in benches free for ten months, whereas untreated plants became heavily infested.

BATEMAN (E. W.) & HEATH (G. D.). **The Generation of insecticidal Smokes.**—*J. Soc. chem. Ind.* **66** no. 9 pp. 325–330, 1 fig., 1 ref. London, 1947.

An account, noticed in more detail elsewhere [*R.A.E.*, B **37** 226], is given of a method of generating insecticidal smokes of DDT or BHC (benzene hexachloride) by the combustion in a container of a mixture of sucrose and potassium chlorate containing DDT or benzene hexachloride and of the investigations leading to its adoption. It should be of value for treating inaccessible sites such as the holds of ships, especially where an immediate kill is required, and for the general disinfestation of buildings such as greenhouses and warehouses. When the smoke generator was used in a village church in which the rafters were attacked by *Anobium punctatum*, Deg., the deposition of powdered wood ceased, but sufficient time had not elapsed for the effectiveness of the treatment to be assessed.

RIEMSCHNEIDER (R.). **Zur Kenntnis der Kontakt-Insektizide. Kontakt-Insektizide auf Halogenkohlenwasserstoffbasis.** [Contribution to the Knowledge of Contact Insecticides. Contact Insecticides with a Halogenated Hydrocarbon Basis.]—*Pharmazie* Beih. **2** Ergänzungsbd. **1** pp. [2+] 77–97, 64 refs. Berlin, 1947.

In this lecture, the author points out that the chief advantage possessed by the recently developed halogenated hydrocarbon contact insecticides over the older materials of natural origin (rotenone, nicotine, the pyrethrins, etc.) is their chemical stability, which gives them a prolonged protective effect. Those

considered are DDT, which is discussed at some length, DDD, benzene hexachloride and fluoro-DDT, and information is given, almost entirely from the literature, on their discovery, composition, preparation, uses, toxicity to Arthropods and harmfulness to warm-blooded animals and plants.

RIEMSCHNEIDER (R.). **Zur Kenntnis der Kontakt-Insektizide. Konstitution und Wirkung von Insektiziden. Mitteilung I.** [Contribution to the Knowledge of Contact Insecticides. Composition and Effectiveness of Insecticides. Communication I.] —*Pharmazie* Beih. **2** Ergänzungsbd. **1** pp. 99–157, 3 figs. Berlin, 1947. **Mitteilung II.**—*T.c.* pp. 159–172, 95 refs.

In the first part of this paper, the author concludes from a review of the literature that there is no close relation between the chemical composition of insecticides and their toxicity to insects and that of the various groups of compounds known to possess contact toxicity, the lactones, which are present in rotenone and the pyrethrins, offer little prospect of further development, so that future work will probably be best concentrated on the halogenated hydrocarbons. He then gives a detailed account of his own work with over 100 materials of this class, used as 10 per cent. and sometimes 1 per cent. dusts in talc. The main test insects were *Melophagus ovinus*, L., and some of the materials that proved sufficiently toxic to them were further tested against lice (*Pediculus humanus*, L., and *Haematopinus* spp.). The insects were dusted in trays in a modified Fransen tower [*R.A.E.*, A **26** 253] and transferred immediately in the trays to an apparatus through which air of any desired constant temperature and humidity is slowly passed. The apparatus is described, and it is stated that the best conditions in it for *M. ovinus* were temperatures of just over 28°C. [82·4°F.], a relative humidity of 60–70 per cent., and diffused daylight. The flies survive for over 24 hours without food, and they were left in the apparatus for up to 16 hours. The use of sucking insects excluded stomach action, and the air current fumigant action.

The following is based on the author's summary of the results. The systematic investigation of the contact action of halogenated hydrocarbons showed that cyclic compounds were more toxic than acyclic. In compounds containing both aromatic and aliphatic components asymmetry was associated with higher toxicity. The introduction of isolated double bonds into the molecule led to a reduction in toxicity. Effective compounds had molecular weights between about 270 and 430, and the best had weights below 360. Among halogenated mono-, di- and triaryl ethanes, the 1,1-diaryl ethanes were the most effective, but when homologues of these with higher molecular weights were tested, effectiveness was lost owing to alteration in certain physical properties, such as the decrease in diffusibility. A further important observation was that toxicity of halogenated compounds of analogous composition decreased with increasing weight of the halogen atom. Tri-halogen methyl groups notably increased effectiveness, and the para position was the most advantageous for halogen atoms in aromatic nuclei.

In the second part of the paper, the results are given of tests with 20 other halogenated asymmetrical paraffins, which confirmed the conclusions reached in the first tests. The compounds used in the two series included 31 that were previously unknown, and a list of these is given.

METCALF (R. L.). **The Mode of Action of organic Insecticides.**—*Rev. chem.-biol. Co-ord. Cent.* no. 1, 84 pp., 6½ pp. refs. Washington, D.C., 1948.

The information in this review of literature on the mode of action of organic insecticides, excluding those used as fumigants, is based on more than 300 papers selected to represent modern view-points and the more important contributions in this field. The subject matter is arranged in nine chapters dealing with

nicotine, pyrethrum, rotenone, organic thiocyanates, dinitrophenols, phenothiazine, DDT and related materials, benzene hexachloride, and organic phosphates. In each case, the chemistry of the material under consideration is briefly reviewed, and summaries are given of work relating to its toxicological, physiological and biochemical reactions in insects, including such aspects as the relation of the chemical structure to toxicity, theories of toxic action, quantitative toxicology, the mode of entrance into the insect body, site of action and physiological and biochemical effects. Some data on the toxicity of DDT and the organic phosphates to warm-blooded animals are also given.

Bennett (S. H.) & Martin (H.). **The qualitative Examination of insecticidal Properties. Progress Report—1947.**—*Rep. agric. hort. Res. Sta. Bristol 1947* pp. 147–156, 11 refs. Bath [1948].

In this third progress report [*cf. R.A.E.*, A **34** 254], the authors describe tests with chlorinated hydrocarbons and with insecticides discovered by Schrader, Kükenthal and their colleagues in Germany. In the first series of tests, larvae of *Mamestra brassicae*, L., were fed daily until they died or pupated on cabbage-leaf sandwiches containing various amounts of γ BHC (benzene hexachloride) and the total amounts consumed adjusted to a larval weight of 0·5 gm. When the daily dose was 0·25 mg., no larvae survived after ingesting a mean of 0·17 mg., when it was 0·125 mg., none survived a mean of 0·1 mg., and when it was 0·025 mg., two died after eating a mean of 0·2 mg. and eight survived a mean of 0·145 mg. The α, β and δ isomers were not toxic at much greater dosages, though some larvae were affected after eating 0·6 or 1·4 mg. δ isomer. Since the toxic dose of γ isomer was higher as the daily intake was lowest, it is assumed that BHC is not a cumulative poison ; either it is incompletely adsorbed, or larvae fed with a sub-lethal dose become tolerant to it. In similar tests with chlordan (90 per cent. agricultural grade) and toxaphene at daily rates of 0·5 and 0·25 mg. and, for comparative purposes, DDT at 0·25 mg., the mean lethal doses were 0·6 and 0·7 mg. for chlordan, 0·74 and 0·18 mg. for toxaphene and 0·12 mg. for DDT. Both chlordan and toxaphene induce slow, ataxic and exaggerated movements in the larvae.

Two samples of HETP (hexaethyl tetraphosphate) prepared by different methods, one of which was that of Schrader, were compared, and a third sample, from a different source, that had been stored for six months in a glass-stoppered bottle with a cracked neck was also included to see whether it had deteriorated. Filter papers (9 cm.) were treated with 0·5 ml. of 10 per cent. solutions of the samples in acetone, water or aqueous acetone (1 : 1 v/v) that had been prepared one hour or seven days previously, and allowed to dry for 20 minutes, after which adults of *Calandra granaria*, L., were confined on them. The results showed that the three products did not differ much in toxicity. For the acetone solutions one hour and a week old, the percentages paralysed after 18 hours were 94·5–97·5 and 95–97·5, respectively, and the percentages killed were 41–44 and 49–57 in 42 hours and 72–78 and 89–90 in 70 hours. The solutions in water and in aqueous acetone lost some of their toxicity within an hour of preparation and all of it within a week. In similar tests with woodlice, solutions 2 and 24 hours and 6 days old were tested, the papers were dried for two hours, and the woodlice exposed to them for 28 hours. There were few or no survivors in any tests except those with the aqueous-acetone or water solutions six days old, and even those still possessed considerable toxicity. Larvae of *M. brassicae* given leaf sandwiches containing 0·025 ml. HETP died within three days after eating little. Owing to its increased instability in the presence of alkali, HETP is unsuitable for use with alkaline spray materials. Parathion (diethyl p-nitrophenyl thiophosphate) was found by Schrader to be promising for this purpose, and two samples, one prepared in Germany and one in England, were tested by the sandwich method against larvae of

M. brassicae at a daily dose of 0·05 mg. The larvae died within 20 hours and the mean lethal dose for both samples was 0·036 mg., whereas that of DDT and γ BHC under similar conditions is of the order of 0·1 mg. Parathion caused violent convulsions, much ejection of liquid and discoloration of the body.

Schrader found that certain compounds of widely separated types, notably certain derivatives of fluoroethyl alcohol and certain alkylamino-phosphorus compounds, can be absorbed by, and translocated in, plants, so that all parts of the latter become toxic to insects. Compounds with this property have been termed systemic insecticides, but all those known to possess it also render the plants highly toxic to man and domestic animals. Since samples of those studied by Schrader were not available, tests were carried out with bis (2-fluoroethoxy) methane, applied as an aqueous 1 per cent. solution to potted plants that were subsequently infested with insects. Larvae of *Callimorpha* (*Tyria*) *jacobaeae*, L., placed on groundsel plants [*Senecio vulgaris*] in 3 in. pots that had been watered the day before with 10 ml. of the solution fed little and became affected or moribund within 24 hours. When colonies of *Aphis fabae*, Scop., were placed on broad beans that had been watered with 10–100 ml. solution per 8 in. pot, there were few or no survivors five days later ; watering plants already infested by *A. fabae* with 5 or 10 ml. of the solution reduced infestation in three days, and a dose of only 0·05 ml. per pot caused a noticeable reduction. Damage by larvae of *Mesographe* (*Pionea*) *forficalis*, L., *Pieris brassicae*, L., *P. rapae*, L., *Plutella maculipennis*, Curt., and *Mamestra brassicae* to cauliflower plants in 10 in. pots treated with only 0·1 gm. of the insecticide and left out of doors was less than in the controls, and other plants remained free from infestation by *Pieris brassicae* and *P. rapae* for more than three and two weeks when treated with 50 or 10 ml., respectively ; eggs were freely laid on the plants, but the larvae died, presumably after eating a trace of the tissue. The lethal dose could not be determined, since the larvae refused to eat disks cut from the treated leaves. In tests designed primarily to establish that the insecticidal effect was not a fumigant action [but *cf.* **37** 487], the petioles of cabbages were inserted in specimen tubes containing water or a 1 per cent. solution of the insecticide, and the tubes were placed in beakers containing the insecticide solution or water, respectively, so that each leaf was over both insecticide and water. Young larvae of *P. brassicae* were then transferred to the leaves, and only those leaves with their petioles in water were eaten by them.

Mature grain produced by wheat plants in 10 in. flower pots watered when in flower with a 1 per cent. solution of the fluoroethoxymethane at rates ranging up to three applications of 50 ml. each or a 0·1 per cent. solution of anhydrous sodium selenate (another systemic insecticide [*cf.* **36** 289–291, etc.]) at up to two applications of 100 ml. was infested with adults of *Calandra granaria*, which were removed and counted after four weeks, and the grain then kept for a further four weeks. Neither material produced grain that was directly toxic to the weevils, but the highest rate of the selenate prevented the production of any new adults, though it also impaired the size and quality of the grain. The apparent responsibility of selenate treatment for the absence of eggs and larvae from the grain suggests the possibility that certain vitamins or proteins containing sulphur are concerned in the reproductive process, which becomes deranged in the presence of the analogous selenium compounds.

PRENTICE (I. W.). **Resolution of Strawberry Virus Complexes. III. The Isolation and some Properties of Virus 3.**—*Ann. appl. Biol.* **36** no. 1 pp. 18–25, 1 pl., 11 refs. London, 1949.

The following is virtually the author's summary. Aphids (*Capitophorus fragariae*, Theo.) allowed to feed for several days on a strawberry plant with

severe crinkle transmitted two viruses. The isolation and properties of one (virus 1) have already been described [*R.A.E.*, A **35** 207 ; *cf.* also **37** 326]. The other (virus 3) was separated by transferring the Aphids to fresh indicators after 24 hours. Virus 3 was transmitted by Aphids that had been allowed to feed on an infected plant for six days or more and persisted in the vector for several days. There was some evidence that the virus has a latent period in the vector. The symptoms produced by virus 3 on wild strawberry and Royal Sovereign strawberry are described. On Royal Sovereign, viruses 1 and 3 together produced symptoms of severe crinkle and viruses 2 and 3 together produced yellow-edge. A form of severe crinkle is thus shown to be caused by a virus complex that can be resolved by means of the vector, and severe crinkle is shown to be etiologically distinct from mild crinkle.

BROADBENT (L.). **Factors affecting the Activity of Alatae of the Aphids** *Myzus persicae* (**Sulzer**) **and** *Brevicoryne brassicae* (**L.**).—*Ann. appl. Biol.* **36** no. 1 pp. 40–62, 20 figs., 16 refs. London, 1949.

The following is based largely on the author's summary of laboratory experiments carried out at Rothamsted in view of evidence in the literature in conflict with Davies' view [*R.A.E.*, A **23** 492] that flight of *Myzus persicae*, Sulz., is inhibited by high humidity. Apparatus was designed for testing the frequency of flights of Aphids under different conditions of temperature, relative humidity, light and pressure. It comprised an inverted glass crystallising dish divided into an upper and a lower chamber by means of a piece of fine copper gauze and standing in a petri dish containing liquid to give the desired relative humidity. The Aphids were introduced above the gauze through a hole in the crystallising dish, which was then closed with a thermometer or a length of open tubing. During experiments, the cage was kept in a wooden cabinet with a ground-glass top and a movable window in one side, in which temperature and light could be controlled. The test Aphids were alates of *M. persicae* and *Brevicoryne brassicae*, L., reared on plants in the insectary. Examples tested 1–4 days after metamorphosis flew more often and showed less individual variability than older ones ; with all ages, activity increased for the first few hours under experimental conditions. Starving increased activity for the first 1–2 hours. Aphids used in experiments on two successive days flew less frequently on the second day than others that remained on the plants on the first day. *B. brassicae* was more active than *M. persicae* ; both species showed alternating periods of activity and quiescence.

There was little difference in flight frequency at light intensities between 100 and 1,000 foot-candles, but activity declined rapidly below 100 f.c., and apparently ceased with darkness. Changes in relative humidity temporarily affected flight frequency, a change to a higher humidity retarding and to a lower increasing it, and this may have accounted for Davies' results. After adjusting to the change, Aphids flew readily at all humidities tested between 50 and 100 per cent. at temperatures below 80°F. A combination of high humidity and high temperature (90°F.) sometimes inhibited flight. Changes of pressure often increased activity temporarily, and flight frequency was greater under fluctuating than under constant pressure.

It is concluded that changes in microclimate in crops are adequate to influence frequency of flight of Aphids and consequently the spread of virus diseases.

FIDLER (J. H.). **A three Years' Survey of Potato Aphids in north-east Yorkshire.** —*Ann. appl. Biol.* **36** no. 1 pp. 63–75, 3 figs., 10 refs. London, 1949.

The results are given of surveys made in 1945–47 to determine the suitability of north-east Yorkshire as a centre for the production of high-quality seed

potatoes, using the frequency of Aphid vectors of virus diseases as a criterion. The number of Aphids per plant was found to provide the most suitable index for this purpose [*cf. R.A.E.*, A **37** 413]. Four species were observed, of which *Myzus persicae*, Sulz., was present on every potato crop examined during the three seasons, *Aphis rhamni*, Boy., was numerous only in 1947, *Macrosiphum solanifolii*, Ashm., was common in 1946, and *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.) was found in very small numbers at one place near York each year and elsewhere only occasionally. It was concluded that the production of seed potatoes is not advisable in the south Wolds, since winter crucifers, on which *Myzus persicae* can overwinter, are grown there, and Aphid populations are generally rather high. Furthermore, potato crops in this district usually become infested by Aphids early in July, which is of importance, since rogueing for leaf-roll cannot be completed much earlier than the end of that month. In general, potato crops in the north Wolds and the Hambleton Hills are almost free from Aphids until the end of July ; numbers are rather lower in the former where, however, there is a risk of infection by scab (*Actinomyces* spp.). The evidence with regard to variation between fields is less reliable, but relatively large maximum populations of Aphids generally develop in fields that are very sheltered, especially from east winds, though if there are no winter food-plants close at hand, this maximum will not be reached until late in the season. Sheltered fields may, however, receive fewer migrant Aphids than exposed ones [*cf.* **35** 196], and their relative suitability depends on the weather during the periods in spring and early summer when the Aphids are migrating and breeding. It is therefore not possible to forecast exactly the number of Aphids and the extent of virus spread to be expected in any particular field, but the fields in which crops are likely to prove most successful and whether a farm is in an unsuitable district can usually be indicated.

Way (M. J.). **A Technique for determining the Stomach Poison Effect of Insecticides used against Leaf-eating Insects.** —*Ann. appl. Biol.* **36** no. 1 pp. 86–112, 1 pl., 11 figs., 24 refs. London, 1949.

This account of methods for testing stomach poisons against leaf-feeding insects includes descriptions of a technique for applying measured quantities of an insecticide as a mist to leaves in a spray tower, methods for feeding large numbers of individual insects on leaf areas bearing known deposits of insecticides, and one for maintaining the treated insects under controlled conditions. The feeding methods comprise one for small Lepidopterous and Coleopterous larvae and two for larger Lepidopterous larvae, in all of which the leaf portions are arranged or shielded so that only the head and mouth-parts of the larva come in contact with the treated surface. The problems associated with incomplete consumption of the treated leaf portion are discussed. Some insects with erratic feeding habits could not be given quantitative doses by any feeding method, and others were so small that the area consumed in a reasonable time was too minute to be estimated. Experiments with larvae of *Plutella maculipennis*, Curt., provided some evidence that low humidities and long periods of starvation prior to treatment both cause some decrease in resistance. Larvae used in comparative tests should be of uniform age and body weight and should be reared on the same food-plant, as these factors all affect resistance. Mortality was found to be slightly greater when the leaf area on which the dose of insecticide was presented was small than when it was large. The dosage mortality curve for stomach poisons was found to be typically sigmoid ; analysis of results by the method of probits [*R.A.E.*, A **22** 440] therefore proved satisfactory. When lead arsenate was used against fifth-instar larvae of *Phlogophora meticulosa*, L., the ratio of weight increase to increase in median lethal dose was found to be constant.

Lord (K. A.). **The Effect of Insecticides on the Respiration of *Oryzaephilus surinamensis* : an Attempt to compare the Speeds of Action of a Number of D.D.T. Analogues.**—*Ann. appl. Biol.* **36** no. 1 pp. 113–138, 17 figs., 14 refs. London, 1949.

The following is virtually the author's summary. A description is given of a method for observing the effects of non-volatile contact poisons on the oxygen uptake of groups of adults of *Oryzaephilus surinamensis*, L. Toxic concentrations of DDT and of its analogues applied as dusts to *O. surinamensis* increase the rate of oxygen uptake ; sublethal concentrations appear to have no effect. The total oxygen uptake of groups of starving *O. surinamensis* appears to be constant, whether or not they are treated with DDT or its analogues. In each case a linear relationship appears between length of life and total volume respired before death.

The stimulus of DDT to *O. surinamensis* is apparently quantal, and the magnitude is independent of the concentration of DDT in the dust. The stimuli resulting from the action of DDT and its analogues are approximately equal, as are the rates at which the insects die. There is, however, apparently a correlation between molecular weight and length of life, insects treated with the poisons of lower molecular weight tending to die more rapidly than those treated with the analogues of high molecular weight [*cf. R.A.E.*, A **37** 411]. The effect of BHC (benzene hexachloride) on the respiration of *O. surinamensis* is shown to be similar to that of DDT.

The effects of a number of insecticides on the oxygen uptake of *O. surinamensis* were compared. As a result, the insecticides are classified in two groups ; those stimulating respiration, including DDT, BHC, and pyrethrins, and those depressing it, including rotenone and a thiocyanate (Lethane B 71).

Martin (H.). **The Insecticidal Properties of certain Organo-phosphorus Compounds.**—*Ann. appl. Biol.* **36** no. 1 pp. 153–155, 12 refs. London, 1949.

In this summary of findings on the properties of the organo-phosphorus compounds recently developed as insecticides in Germany [*cf.* next abstract and *R.A.E.*, A **37** 482], it is stated that in tests at Long Ashton, parathion (p-nitrophenyl diethyl thiophosphate), known in Germany as E 605, inhibited the hatching of eggs of Aphids and the winter moth [*Operophtera brumata*, L.] when applied at concentrations of 0·05 per cent. or less. Unterstenhöfer reported that parathion is absorbed by plant tissues, and since it is highly toxic to man, it cannot be recommended as yet for use on food crops. A similar warning is given with regard to the systemic insecticides, whether based on phosphorus or not [*cf.* **37** 482, 487]. McCombie & Saunders reported that exposure to fluoroethyl alcohol, which would be produced by the hydrolysis of bis (2-fluoroethoxy) methane, at a concentration of 0·1 gm. per cu. m. for ten minutes caused test animals to die with violent convulsions within an hour, though they were apparently unaffected immediately after exposure. It is probable that bis (dimethylamino) fluorophosphine oxide is stable, but they also found that exposure to the related alkyl fluorophosphonates at a concentration of 1 part per million for five minutes induced severe meiosis and loss of powers of visual accommodation for several days in man, while amounts too low to be detected chemically caused blurring of vision. The tetrakis dimethylamide of pyrophosphoric acid [also known as bis[bis (dimethylamino)] phosphonous anhydride] would probably give rise to less dangerous compounds. Contact with these compounds and with plants containing them caused no apparent ill effects among workers at Long Ashton.

COATES (H.). **The Chemistry of Phosphorus Insecticides.**—*Ann. appl. Biol.* **36** no. 1 pp. 156–159, 7 refs. London, 1949.

Schrader considered the organo-phosphorus insecticide discovered by him and sold in Germany under the name Bladan to be hexaethyl tetraphosphate and to possess a symmetrical branched-chain structure. He prepared it by heating a mixture of 1 mole of phosphorus oxychloride and 3 moles of triethyl phosphate, but it can also be prepared from mixtures of ethyl alcohol and phosphorus oxychloride or of phosphorus pentoxide and triethyl phosphate. It now appears that the material is an equilibrium mixture of the linear polyphosphoric esters, hexaethyl tetraphosphate, pentaethyl triphosphate and tetraethyl pyrophosphate, with some unreacted triethyl phosphate and acidic by-products [*cf. R.A.E.*, A **37** 214]. No appreciable amount of the compound possessing the branched-chain structure is present, since only a very small quantity of orthophosphoric acid is produced on complete hydrolysis.

The active principle is believed to be tetraethyl pyrophosphate, which, when pure, is five times as toxic as the mixture, and it is becoming current practice to refer to commercial material containing approximately 20 per cent. tetraethyl pyrophosphate as HETP and that containing 40 per cent. or more as TEPP. Tetraethyl pyrophosphate is prepared by the reaction of dry silver pyrophosphate and dry ethyl iodide under reflux or by allowing ethyl alcohol and phosphorus trichloride to react at 0–10°C., chlorinating the diethyl hydrogen phosphite so formed at the same temperature to give diethyl chlorophosphonate, and allowing this to react with excess triethyl phosphate at 140°C. The methods available for the estimation of tetraethyl pyrophosphate depend on the relative rates of hydrolysis of the various esters. Hexaethyl tetraphosphate and pentaethyl triphosphate are split on hydrolysis very rapidly, but the derivatives of pyrophosphoric acid thus formed and the tetraethyl pyrophosphate itself then undergo hydrolysis at a much slower rate. By carrying out a time titration on separate samples, using methyl orange and phenolphthalein as indicators, the amount of tetraethyl pyrophosphate in the mixture can be calculated more conveniently than by the methods hitherto available, which involve extraction with chloroform or benzene.

The rate of hydrolysis of tetraethyl pyrophosphate and several related compounds was investigated. Under conditions of maximum hydrolytic stability (pH 6 or less), tetraethyl pyrophosphate underwent 50 per cent. decomposition in seven hours at 25°C. [77°F.] and in 15 hours at 15°C. [59°F.]. The other compounds were more stable and comprised, in order of increasing resistance to hydrolysis, monothionopyrophosphate, diethyl p-nitrophenyl phosphate (known in Germany as E 600), and parathion (O,O-diethyl O,p-nitrophenylthiophosphate).

The paper also includes outlines of the methods of preparation of two systemic insecticides, bis(dimethylamino)fluorophosphine oxide and pyrophosporic tetrakis(dimethylamide) [also known as bis[bis(dimethylamino)] phosphonous anhydride].

BENNETT (S. H.). **Preliminary Experiments with Systemic Insecticides.**—*Ann. appl. Biol.* **36** no. 1 pp. 160–163, 4 refs. London, 1949.

The results are given of investigations on the action of three compounds stated to confer insecticidal properties on plants that have absorbed them. The compounds were bis(2-fluoroethoxy)methane, bis(dimethylamino)fluorophosphine oxide and a commercial preparation based on tetra(dimethylamido) pyrophosphate [also known as bis[bis(dimethylamino)] phosphonous anhydride] and they are referred to as F, D and P, respectively. Experiments in 1947, which were carried out with F only, have been noticed from a more detailed source [*R.A.E.*, A **37** 483]. Those in 1948 showed conclusively that all three materials have a fumigant action [*cf. loc. cit.*] on the mealy cabbage aphis

[*Brevicoryne brassicae*, L.] though that of P is only slight. It was found that if the insecticide was applied to a filter paper roughly equivalent in area to the leaf span of the plant and the paper was placed round the base of the plant, the number of Aphids was greatly reduced though all were not killed. On the other hand, plants receiving the same amount of insecticide applied to the soil, which was then waxed to prevent fumigant action, were completely cleared of Aphids within 3–7 days, although the initial action was much slower. About 40 parts per million in soil freed the plants from infestation, and 200 p.p.m. kept them uninfested for $4\frac{1}{2}$ weeks. When applied to the soil, the compounds therefore appear to act first as fumigants and later as systemic insecticides. In order to avoid the fumigant effect from treated soil, further tests were made with willow sets rooted in nutrient solutions, using *Phyllodecta vitellinae*, L., as the test insect. When beetles were placed on muslin stretched over the lower halves of 9-cm. petri dishes containing 5 ml. of an aqueous solution of the insecticide and covered by the upper halves, P had no fumigant action, but solutions containing as little as 50 mmg. D or F acted as fumigants, the former being the more rapid and effective. Beetles confined with leaves removed from sets that had taken up the insecticide through the roots died quickly and after only a trace of leaf tissue had been eaten, indicating that the leaf tissue acts as a fumigant. On the assumption that an insecticide absorbed by a plant becomes distributed evenly throughout it, the relative effectiveness of different parts of a plant was tested by exposing beetles to leaves, stems and shoots removed from a set that had absorbed a known weight of insecticide. Equal weights of the different plant parts were used, the weight selected being chosen to contain 0·5 mg. insecticide. The periods required for all the beetles to become moribund when exposed to the overall action of leaf, shoot and stem and to the action of aqueous solutions containing 0·5 mg. and 50 mg. insecticide were 5, 24, 40, 65 and 4 hours, respectively. Beetles exposed to the fumigant action of shredded or whole leaves became moribund in 6 and 12 hours, respectively, and both overall and fumigant actions were retarded under conditions of high humidity. In an experiment to determine the speed of translocation of the material through the plant, leaves on a willow set were infested with *P. vitellinae* and sealed in glass tubes, after which the root was placed in an insecticidal solution. Eight hours later, leaves near the enclosed ones killed beetles very quickly when removed from the plant, but the beetles in the tubes were unaffected, presumably because the atmosphere became saturated with water vapour, which either prevented the insecticide from reaching the leaf or prevented the vapour from being given off by it.

In solutions containing 50 mg., D or P were ineffective as fumigants against last-instar larvae of *Pieris brassicae*, L., but F caused them to become moribund in four hours. Larvae exposed on filter paper to the overall action of aqueous solutions containing 10 mg. F or D became moribund in four and 48 hours, respectively, but P was again ineffective. A solution containing 50 mg. F was effective as a fumigant against larvae of the tomato moth [*Diataraxia oleracea*, L.] but tissue from plants treated with it was not, though it appeared to be repellent and some larvae died after eating very little of it. Similar solutions of P and D had no fumigant action, and tissue treated with P was also ineffective, but tissue treated with D showed both fumigant and overall action.

Though F and P applied to the soil at a rate of 200 p.p.m. kept cauliflower free from infestation by *Brevicoryne brassicae* for 3–4 weeks, only D was toxic to larvae of *P. brassicae* seven weeks after application. All the materials were phytotoxic under certain conditions, even at very low concentrations. D produced marginal scorch on cauliflowers at 20–50 p.p.m. P did not injure plants when applied to the soil, but was injurious when the roots were placed in solutions containing it.

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CONTENTS.

CONTENTS—*cont.*

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by the South Essex Recorders, Ltd., Ilford.

(1668) Wt. P18/3825 1/50 S.E.R. Ltd. Gp. 432.